

AUTOMOBILE
PAINING

F.N. Vanderwalker



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Automobile Painting *and* Carriage and Wagon Painting

A Practical Instruction Book Covering Every Detail of
the Latest and Best Methods Specially Designed
for the Average Painter and Car Owner

By

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ing and Interior Decorating"

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PREFACE.

The purpose of this book is to present the practices of today useful in painting and refinishing automobiles, carriages and commercial vehicles by the painter or the car owner.

Many cars are now painted by those who are without much information or experience concerning such work. Under such circumstances the effort seldom results in a fine appearing surface, but had they known what kind and how much preparation of the surface is necessary to insure a beautiful finish, what materials and tools to use as well as how to use them, and the general requirements, they might easily have succeeded with no more effort.

To supply this needed information, to give definite answers to the specific questions which naturally arise concerning details and to furnish a practical working method is the aim of this work.

THE AUTHOR.

CONTENTS

	PAGE
SECTION NUMBERS	6
OPERATION NUMBERS	7
CHAPTER I	
WHO CAN PAINT AN AUTOMOBILE?	9
CHAPTER II	
MATERIALS	11
CHAPTER III	
TOOLS	19
CHAPTER IV	
HOW MANY COATS?—WHERE TO PAINT THE CAR—HOW MUCH MATERIAL?—DRYING CONDITIONS—THE MIXING OF COLORS, PIGMENTS AND LIQUIDS	26
CHAPTER V	
FINISHING THE NEW CAR	37
CHAPTER VI	
TAKING CARE OF THE AUTO FINISH—LAKE COLOR PIG- MENTS—FINISHING ENGINES—PAINTING THE CAR WHITE	87
CHAPTER VII	
A QUICK JOB—NEW CARS	94
CHAPTER VIII	
REFINISHING OLD CARS—A FIRST CLASS JOB—A QUICK JOB	100
CHAPTER IX	
INITIALS AND MONOGRAMS	116
CHAPTER X	
A TOUCH-UP AND VARNISH JOB	130
CHAPTER XI	
THE AUTOMOBILE PAINT SHOP	135
CHAPTER XII	
CARRIAGE AND WAGON PAINTING	150
CHAPTER XIII	
FACTORY PAINTING METHODS—SPRAYING, FLOWING, DIPPING AND BAKING	156
CHAPTER XIV	
THE ENAMELING PROCESS	196
CHAPTER XV	
COLOR SCHEMES	200

SECTION NUMBERS

The following subjects are arranged in sections and numbered for quick reference.

	PAGE
1. How Many Coats?	27
2. Where to Paint the Car	29
3. How Much Material	30
4. Drying Conditions	31
5. The Mixing of Colors, Pigments and Liquids	33
6. Schedule of Operations—New Cars	36
7. Rubbing Mouldings	52
8. Rubbing Large Flat Areas	53
9. Rubbing Curved Small Surfaces	57
10. Rubbing Lead Ground Coats	57
11. Rubbing Varnish	58
12. Ground Colors	60
13. Flowing on Varnish	71
14. Taking Care of the Auto Finish	87
15. Lake-Color Pigments	88
16. Finishing Engines	91
17. Painting the Car White	91
18. A Quick Job Schedule	95
19. The Quickest Job	97
20. Refinishing—Old Paint to Be Removed	106
21. Refinishing—Old Paint Not to Be Removed	107
22. Refinishing—A Quick Job	111
23. Renewing Auto Tops	114
24. Brass Varnish and Lacquer	114
25. Finishing a New Carriage	150
26. Refinishing a Carriage	153
27. Wagon Painting	154
28. Touch-Up and Varnish Jobs—Wagons	155
29. Spraying Paint, Varnish, etc.	165
30. Flowing on Paint and Varnish	178
31. Dipping	187
32. Baking	189

OPERATION NUMBERS

The following operations are arranged in sub-divisions and numbered for quick reference.

	PAGE
1. Cleaning the Surface	37
2. Sandpaper to Roughen Up	38
3. Priming Coat	39
4. Putty	42
5. Sandpapering	43
6. Dust Off—Wash	44
7. Roughstuff Filler	45
8. Stain Guide Coat	49
9. Rubbing—Pumice and Water	50
10. Lead Ground Coats	59
11. Horse Hair Rub	62
12. Knifing Lead and Glaze Putty	62
13. Japan Color—with Turpentine	64
14. Japan Color—with Varnish	67
15. Rubbing Varnish—with Color	68
16. Rubbing Varnish—Clear	76
17. Body Finishing Varnish	77
18. Polish Ready for Service	78
19. Japan Color—with Finishing Varnish	79
20. Chassis Finishing Varnish	80
21. Ivory or Coach Black	81
22. Black Japan	81
23. Wood Filler	83
24. White or Tinted Enamel Wheels	84
25. Natural and Stained Wood Finish	85
26. Stains	85
27. Removing Mud and Grease	101
28. Removing Old Paint	102
29. Filling Holes, Dents and Cracks	103
30. Taking Off Wax Coatings	104
31. Touching Up Bare Spots	105

AUTOMOBILE PAINTING

CHAPTER I

Who Can Paint an Automobile?

Can a car really be given a fine finish outside of an automobile factory? Painters, and especially carriage painters, know it can, and so that question does not come up with them. At any rate it is entirely possible and practicable for a car owner, a house painter or an automobile mechanic to produce a presentable job, if he will but use the same intelligence exhibited in his every day line of work, provided he doesn't let his zeal to view the finished effect run away with his judgment, and so rush along with the painting process so fast that the job is spoiled. Carelessness about details always goes with hurried work. Paint and varnish are materials which must have their own good time to dry, if really long service is expected of them.

To the car owner the painting offers a considerable saving in money, since he can do the job for the cost of materials. The sport of driving a car to many men comes largely from the feeling of independence which a full understanding of every detail of construction, operation and maintenance gives. Mechanics, and those who have been mechanics in various trades, especially are in this class. Then there are others with whom it is strictly a matter of economy in maintenance, because upon their ability to keep down the expense of operating a car depends their right to afford the pleasure of owning one. One can paint his car for about ten dollars or less, when it would cost fifty to seventy dollars to have others do it; there is quite some saving to pay for the trouble.

To house and sign painters the field of automobile painting offers a large opportunity to develop a paying business. It is without the keen competition under

which they are working. It offers steady employment, and especially an income for the dull seasons.

The garage owner whose winter income depends largely on rentals and overhauling jobs will find the painting of cars generally repaired to be a profitable addition to his earnings. He has the room usually, and needs but to study the work to be able to handle it. Rebuilt cars which he may be holding for sale offer an excellent opportunity to increase his profit. A few coats of paint and varnish have sold more cars than much talking ever did. Painting really increases the value of an automobile as well as to make it sell more easily.

Before you have gone very far into this book, you will readily see that it does not present any wonderful new material by the use of which you can perform such a miracle as producing a really fine and artistic finish on an automobile body with but one or two coats and without the use of time tried filling and surfacing methods. Frankly, it cannot be done, as you will readily agree after having tried it. Any method which produces a finish of good appearance requires time and more labor than the brushing on of one or two coats of materials. Later in this work finishing methods will be given which require the minimum of labor, number of coats, time and expense and which will at the same time result in a good looking, serviceable finish.

CHAPTER II.

Materials

The materials used for automobile painting determine in a large degree the success which will be met with on completing the job. They are so important that the most skillful of mechanics cannot, with poor materials, turn out a job of painting that is either good to look at or durable. Not only is the use of cheap material unsuccessful, but likewise the wrong materials of even the finest quality fail as completely to accomplish the desired result. Probably more attempts at automobile painting fail because improper materials are used than for all other reasons combined. When for instance, oil is used as a thinner in place of turpentine the coat neither dries nor hardens as it should to stand the necessary rubbing, leveling and smoothing processes. When ordinary house colors ground in oil are used in place of colors ground in turpentine or japan a greasy coat results which does not dry properly. And the use of cheap or improper varnishes leads, usually, to the most disreputable appearing surfaces one is able to imagine. Even with their discouraging appearance they are not durable enough to justify the time spent on them.

Anyone who will take up a pencil and figure the probable cost of materials needed for painting the average car, will quickly see how wasteful of time and material, how far from being economical it is to buy cheap materials. True enough, first class automobile varnish costs four to eight dollars per gallon, while three dollars will buy a gallon of ordinary varnish—but only about half a gallon is needed for the average car, so the cost of the finishing varnish is but two to four dollars. In the same manner the colors and other materials cost a little more than ordinary goods, but the quantity of each needed is so small that the total

cost is only about one tenth the cost of a finished job turned out of an auto painting shop.

Use the very best materials you can buy, and only such as have been especially made for automobile and carriage painters' use. Have no faith in the many ready mixed paints and so-called carriage color varnishes which are claimed to give you a wonderful finish in one or two coats without preparing the surface, when the most skillful professional automobile painter himself cannot produce a job of respectable appearance and reasonable durability without the necessary filling and rubbing processes and with less than six or eight coats.

A complete list of the materials needed follows:

Red Lead, for priming metal surfaces.

Metal Primer, such as can be had from all well known varnish manufacturers. Made especially for metal auto bodies and chassis.

White Lead in oil, strictly pure Carter Coach & Car Lead preferred.

Roughstuff. It can be purchased in the form of a heavy paste, in one pound cans and larger, at about twenty cents per pound from varnish and color manufacturers. It should be thinned to stout brushing consistency, about like thick cream, with turpentine and it is then ready to be brushed on. It comes light or dark for use under light tints or dark colors. The man who has but one or two cars to paint had best buy his roughstuff ready for use. The painter with a shop can make it more cheaply where a quantity can be used. The materials needed are white lead and what is called "Keystone Filler," ground in japan and varnish. The formulae will be given under the proper heading. Keystone Filler sells at about \$1.65 per gallon and 90c per half gallon.

Dry White Lead for making putty.

Dry Bolted Whiting, for putty.

Linseed Oil, Raw.

Turpentine.

Japan Gold Size or Coach Japan—cost about 85c

per quart. A liquid to be used to bind paint and cause it to dry hard. When used as the liquid with putty and fillers it causes them to set quickly and very hard. It may be purchased from varnish makers and paint jobbers.

Varnishes. There are several varnish manufacturers who make first class automobile varnishes. The Sherwin-Williams Co., Chicago, and Valentine & Co., Chicago, are probably to be preferred from among the American manufacturers, while Robt. Ingham Clark & Co.'s products are among the best English varnishes for automobiles; they may be purchased through paint jobbers, as Pratt & Lambert, Chicago, have the American agency.

A Quick Rubbing Varnish, or what the English call Flatting Varnish, is needed for mixing with the second color coat and to be used clear as the first varnish coat. It dries hard, dust free in six or eight hours, and may be rubbed in about 48 hours.

An elastic rubbing varnish would seem to be the best for the reason that it allows more freedom and time in working and enables the painter to flow on say an entire wheel or part of gear and then return and lick the defects or thick edges out in time for the whole mass to flow together in a body. Thick edges, laps, etc., should be avoided, and, naturally, they can best be eliminated by using an elastic varnish that sets slowly enough to allow for catching up any possible defects without pulling the coats in layers or causing them to pile up.

Color Varnishes are generally about the same as rubbing varnishes except that a certain amount of Japan color has been mixed into them. They may be purchased in most standard colors. They can be rubbed the same as rubbing varnishes and are used in place of them.

For the last coat what is called Body Finishing Varnish is needed. It is more elastic, dries more slowly and not so hard as rubbing varnish.

As a rule ordinary carriage varnishes are not very

durable on automobiles, because of the hard usage resulting from so much vibration, mud, oil, grease, road-oil and the dust driven against the car by its great speed. The varnishes made especially to withstand these conditions had best be used.

The line of automobile varnishes of one of the best known manufacturers is listed below:

	Price Per Gal.
Body Varnish For Finishing Coats Only.	\$6.00
Finishing Varnish For Finishing Coats Only.	5.00
Chassis Finishing The Best Finish for the Hoods, Fenders and Under- parts of Automobiles.	5.00
Gear Varnish For Finishing Coats where a heavier, quicker Var- nish than the Body or Finishing is desired.	4.50
Quick Gear Varnish For Finishing Coats on Quick Work.	3.50
Quick Finishing For Finishing any Equipment where a very quick Hard Drying Finish is required.	4.50
Leveling Varnish A 36 to 48 hour Rubbing.	4.00
Flatting Varnish An 18 to 24 hour Rubbing.	3.00
Pale Body Varnish For Finishing Coats where a paler Varnish than our regular Body is desired.	6.00
Pale Gear Varnish For Finishing Coats where a heavier, quicker Var- nish than our Pale Body is desired.	5.00
Pale Quick Gear Varnish For Finishing Coats on Quick Work where a paler Varnish than our Quick Gear is desired.	4.00

Pale Leveling Varnish..... 5.00

A 48 hour Rubbing for use where a paler Varnish than our Leveling is desired.

Pale Flatting Varnish..... 4.00

A 24 hour Rubbing for use where a paler Varnish than our Flatting is desired.

Black Japan. For black fenders, chassis and hood what is called Black Japan is often used as undercoats of varnish. It is in reality a hard drying varnish which is not transparent, and which dries in eight or nine hours and may be rubbed in 48 hours. It may be used as a finishing varnish for these parts also, or coated with a regular chassis finishing varnish.

It is not advisable to use two different brands of varnish on the same car; that is, if two coats of rubbing varnish are used take the varnish from the same can for both coats. Likewise do not use two different brands of finishing varnish on a car which receives two finishing coats. There is a difference in elasticity between different brands of the same kinds of varnish. When the surface gets hot from the sun or the engine one varnish coat may expand more than the other and cause what is called "crazing," which means small hair lines or cracks in the varnish.

Enamel. When wheels are to be white, cream, Ivory, straw or some such light delicate tint you can do no better than to use one of the first class white enamels made for house work, after giving the necessary ground coats as mentioned later. The two best known enamels for this purpose are the English product called "Vitalite," sold by Pratt & Lambert, Chicago, and the Dutch enamel called "Ripolin," sold by most paint jobbers. Both come only in the white, but can readily be changed to any light tint by adding the right color ground in japan as listed later in this chapter. These enamels are put up in cans from one-fourth pint at about 20c, a quart at \$1.35, half gallon at \$2.60, and one gallon at \$5.00.

Liquid Paint and Varnish Remover. This preparation will be a labor saver when removing old paint

and varnish from wheels and other parts, although the paint burner or gasoline blow torch is more useful for many surfaces. This liquid remover can be had from any paint dealer.

Colors. Colors used for automobile painting are ground in Japan. Colors ground in oil are not suitable, except for tinting ground coats. The so-called carriage paints carried by most paint stores are of no use at all for this purpose, they are simply colors and varnishes mixed together, useful, perhaps, to paint an old wagon when even the wheels are not taken off. They produce quick jobs, but their virtues end about at that point.

A complete list of the Japan Colors carried in stock by a Chicago jobber follows. They are put up in 1 lb., 5 lb., 10 lb. and 25 lb. cans. The list prices given are subject to 50% discount to painters. Varnish manufacturers also make such colors and all paint jobbers can supply them. Japan colors come in paste form and are to be thinned to brushing consistency with turpentine and thoroughly beat up.

SUPERFINE COACH PAINTERS' COLORS.

For Coach, Carriage and Car Work. The Best Ever Made.

These colors are ground in japan and will dry at once. Put up in one pound cans or five pound press cans.

	Per lb.		Per lb.
Black, Coach Painters' Drop.....	\$0.44	Blue, Ultramarine .....	.88
Black, Ivory .....	.52	Brown, Russett .....	.80
Black, Jet .....	.66	Brown, Vandyke .....	.44
Black, Lamp .....	.44	Car Body Color.....	.54
Black, " M o n o g r a m " Drop .....	.40	Car Body Color, Pullman .....	.60
Blue, Azure .....	.54	Dutch Pink .....	.70
Blue, Permanent	1.00	Green, Apple .....	.66
Blue, Perfect	1.50	Green, Brewster Light or Dark .....	.56
Blue, Cobalt	1.20	Green, Brilliant .....	.70
Blue, Peacock .....	.90	Green, Bronze .....	.70
Blue, Prussian	1.10	Green, Concord .....	.56
Royal Purple	1.70	Green, Coach Painters',	

	Per lb.		Per lb.
Light, Medium or		light or dark.....	.54
Dark .....	.60	Vermilion, Bay State...	.84
Milori Green	1.50	Vermilion, English, light	
Green, Merrimac, L. M.		or dark	1.70
or D. ....	.70	Vermilion, unfading....	.72
Green, New Haven.....	.90	Vermilion, one coat....	.60
Green, New	1.10	Vermilion, Eureka	1.00
Green, Olive .....	.66	White, Flake .....	.60
Green, Quaker .....	.60	Yellow, Canary .....	.76
Green, Sage .....	.70	Yellow, Chrome, light,	
Garnet Color .....	.90	medium or dark.....	.56
Imitation Gold Striping.	1.20	Yellow, Chrome, extra	
London Smoke .....	.80	light .....	.60
Olive Brown .....	.70	Yellow, Concord .....	.56
Golden Ochre .....	.44	Yellow, Milori	1.20
Red, Amesbury	1.00	Yellow, Naples, light or	
Red, Ascot, light or dark	1.10	dark	1.10
Red, Bostonia .....	.90	Yellow, Perfect, light or	
Red, Brilliant	1.20	dark	2.50
Red Carmona, light or		Yellow, Street Car.....	1.50
dark	1.30	Yellow, Primrose .....	.80
Red, Chicago .....	.84	LAKES.	
Red, Coach Painters' ...	1.00		
Red, Cart .....	.70	Carriage Part Lake.....	Per lb. \$0.90
Red, Coral	1.00	Carmine, No. 40, 1-lb.	
Red, Eastern	1.20	cans	9.00
Red, Indian .....	.42	Carmine, No. 40, ½-lb.	
Red, Mystic	1.60	cans.....Per can	4.50
Red, New Haven.....	1.60	Carmine, No. 40, ¼-lb.	
Red, Merrimac	1.00	cans.....Per can	2.50
Red, Permanent .....	.72	Carmine Lake A.....	4.00
Red, Tuscan .....	.48	Green Lake	4.00
Rose, Pink .....	.48	Munich Lake A.....	3.00
Russett Color .....	.70	Opaque Carmine	3.00
Jersey Tan .....	.70	One Coat Claret.....	1.00
Straw Color .....	.70	One Coat Scarlet.....	1.34
Sienna, Italian, raw or		Ground for Carmine....	1.20
burnt .....	.50	Rose Lake	1.40
Umber Turkey, raw or		Scarlet Lake	3.50
burnt .....	.50	Wine Color, A.....	.44
U. S. Mail Red.....	1.00	Wine Color, B.....	.48
Vermilion, American,		Yellow Lake	2.50

White. The white pigment to be used with the above colors for the most part for making various tints and shades is listed as Flake White. This is pure white lead under a different name. It is ground a little

finer than the grade of white lead sold for house painting and with japan or turpentine for the carriage trade, rather than linseed oil. Otherwise the two products are identical.

For ground color coats and, in fact, in most places where white is needed the regular white lead ground in oil for house painting is suitable, if care is taken to get a pure lead that is very fine and really white. See that you get Carter White Lead and you will have the whitest and finest in the land. A special grind of this lead known as Coach and Car Lead is made for the automobile and carriage trade.

For use in lightening up colors which for the most part are transparent or semi-transparent white lead is not the best. Zinc oxide, which can be had from most any paint stock, is not so opaque as lead and is better for this purpose where covering capacity is not wanted.

When using for auto painting, either white lead or zinc ground in oil, the oil is sometimes drawn from the lead. To accomplish this mix the lead or zinc paste with turpentine, using enough of the liquid to make the paste rather too thin for use with a brush. When thoroughly mixed let stand 24 hours, or better yet 48 hours. The oil and turpentine will rise to the top and may be poured off, leaving the lead in the bottom of the pot. Mix the lead thus left with fresh turpentine and it is ready for use alone or as a base for light colors.

Wheels which are to be finished pure white, ivory white, straw, cream or some such very light tint may be built up with pure white lead coats and finished with two coats of high grade white enamel put up for house decorating.

By adding raw sienna to the white enamel a straw, ivory or cream color is produced for finishing coats. Ground coats had best be white. Likewise any light tint may be had by adding the proper japan color in very small amount to the white enamel.

CHAPTER III.

Tools

What was said in the previous chapter about the economy and wisdom of using the very best materials is equally true of tools, with special reference to brushes. The sins of a poor brush, whose only ambition in life seems is to become bald, are indeed great if not numerous. And the poor brush usually, but not always, is the cheap brush. Brush makers, like most manufacturers, are honest and if you pay for a really good brush generally you get it, unless some retailer sells you, at the price of a good brush, what the manufacturer sold him as a cheap one. At any rate buy well known, trade marked brushes having the manufacturer's name on them, preferably the "Rubber-set" brushes or those whose bristles have been vulcanized in solid rubber. Then you will get what you pay for, brushes that will not lose bristles to mar your paint or varnish and waste your time picking them out, brushes having the correct shape, the right spring and good quality of bristles.

Below are listed the brushes which an automobile painter must have to get along. The car owner who has but one car to finish may get along with fewer in number, but certainly he should not attempt to do without equally good brushes.

Brushes for Primer, Roughstuff and Lead Coats.
Use for large surfaces a first class Oval Varnish Brush, preferably set in rubber, like Figure 1, costs about \$1.50 each. The bristles are usually Chinese Black. For small surfaces and mouldings one inch and three

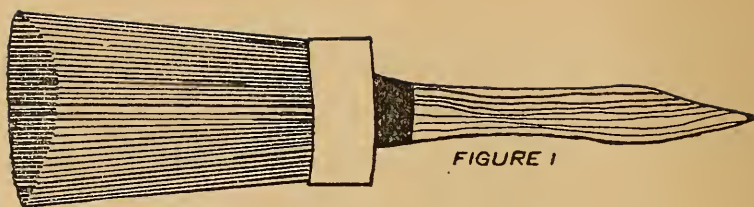


FIGURE 1

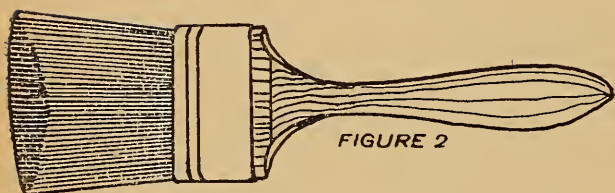


FIGURE 2

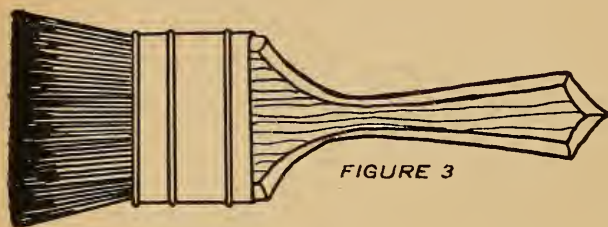


FIGURE 3

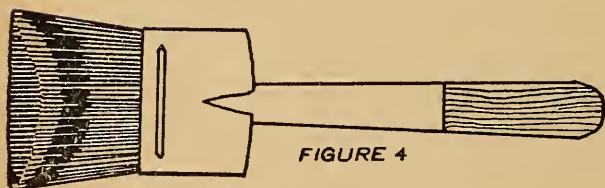


FIGURE 4

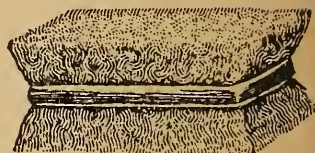


FIGURE 6

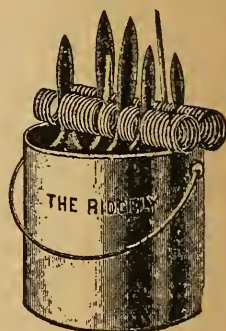
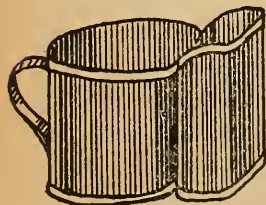
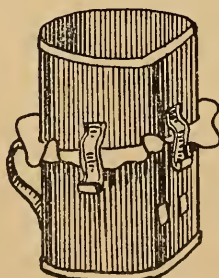


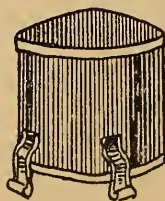
FIGURE 5



Ready for Use.



Ready for Straining.



Straining Cup

FIGURE 7



FIGURE 8

inch flat varnish brushes made of best French bristles or of the same bristles and set in rubber are most suitable. Figure 2 shows such brushes. A one inch size at 50c each and a three inch at about \$1.50 each will serve the purpose.

Brushes for Color Coats. Color coats require more care to secure an even distribution free from laps, brush marks and rough places than any other coats, not excepting varnish coats. Varnish coats help themselves considerably by flowing together and leveling up, which eliminates these defects, but color coats will plainly show careless and crude brush work, especially with varnish over them to emphasize the defects. All of which goes to show that just the right kind of brushes are necessary for spreading color coats. The best color brushes for this purpose are called "Double Thick Camel Hair," "Badger or Ox Hair Color Brushes." They are made in various sizes, a one inch at about 50c each and a three inch at about \$1.80 each are sufficient, usually. Where more than one color is being used at the same time it is, of course, necessary to have a set of brushes for each color. These brushes are flat with rather shorter and softer hair than bristle brushes have. See Figure 3. Every retailer of paint usually has a line of cheap camel hair brushes which are no earthly good for this work, nor for any other so far as the author knows, except to sell. If you cannot get a really good Badger Flowing Brush or a Camel Hair Color Brush, by all means use the flat Chinese Bristle rubberset brushes specified for priming, for roughstuff and lead coats. Do not, however, condemn any brush without a fair trial. Most new brushes lose a few hairs at first. Many of them can be shaken out while the brush is dry. You know, of course, that no brushes are made of real camel hair, but rather the hair is taken from such fur bearing animals as the Russian Gray Squirrel.

Brushes for Varnish Coats. The choice of brushes for use in putting on the varnish coats seems to be pretty well settled as between two general styles. The

first choice is called an "Extra Fitch Hair Flowing Brush, Double Thick." Substantially the same kind of a brush is listed as a "Badger Hair Flowing Brush, Double Thick." Figure 4 shows the style of both brushes, with a long handle and fairly short bristles. They are best set in rubber and once they have been "broken in," as the painter calls it, they are a joy to work with on fine varnish surfaces. These brushes are flat and made in various sizes. A one inch brush at about 70c each and a three inch at about \$1.60 each, will serve the purpose nicely, although in a shop doing considerable business several brushes of each kind are needed.

The second varnish brush which deserves mention is made about the same style and shape but in place of Fitch or Badger Hair they are made of selected Chinese Bristles or the finest French White Bristles. Such brushes have their virtues, to be sure. Being made with longer bristles and thicker they carry a larger quantity of varnish, which is an advantage on large surfaces. The stiffer nature of the brush appeals to the man with strong arm muscles as he can spread the varnish about more quickly than with a soft, short hair brush. The soft hair brush lays the varnish on in a finer manner but the long bristled, firmer brush lays the varnish so fast that it really flows together and levels up, making as fine a finish in the end.

All brushes are better for having been used awhile. Automobile painters use their new varnish finishing brushes in the lead coats first, then in rubbing varnish coats, in chassis finishing and finally for finishing coats of varnish on the body. With this in mind, then, it may be well for one who has but a single car to paint to buy simply two or three first class finishing varnish brushes; that is, the Fitch or Badger Flowing Brushes mentioned, and one three inch flat rubberset bristle varnish brush for spreading roughstuff, which is too stiff to be spread with so soft a brush as those mentioned. After the roughstuff coats have been laid on such a brush will be very useful to dislodge pumice

stone from crevices and panel corners while washing up after rubbing.

While we are thinking about brushes it is in order to specify the manner in which good brushes ought to be cared for:

Any brush which has to be used again next day may most conveniently be left right in the pot of paint or varnish, taking care to see that the bristles, not the handle or metal ferrule, are covered most of the way up with material, and that the whole pot and brush are covered over with paper to be dust tight.

In the paint shop where the brushes are used at intervals of several days or weeks the brushes should be filled, each with their respective materials, and carefully put away in pots or tanks in an upright position, with the bristles off the bottom.

Primer, Roughstuff and Lead Coat brushes are to be put away in a bath of raw linseed oil. The oil ought to be changed every few weeks so it will not become fatty or rancid from oxidation. Hang the brushes upright with bristles off the bottom.

Color Brushes used at short intervals ought to be filled with the color and suspended upright in pots or tanks full of water covering the bristles or above. Keep the bristles off the bottom, so they may not curl up and also to keep them out of the sediment and skins accumulation on the bottom.

Varnish Brushes may be cared for the same as color brushes except that the bath should be varnish, not water. Finishing brushes should preferably be stored in finishing varnish to cover the bristles completely, heel and metal ferrule over the top. Wire Brush Suspenders as shown in Figure 5 are a great convenience.

All brushes which are not to be used again should be wiped out on a board, then soaked in benzine, kerosene or gasoline and finally washed clean with laundry soap and warm water. Lay flat to dry and later wrap up in old newspapers and store where they will not be too dry.

Rubbing Materials. There seems to be but little choice between sandpaper and the newer material called "Steel Wool" for the first cleaning and smoothing up of the car. Both materials come in various grades of fineness and both are numbered to indicate these degrees. The medium fine grades of either materials which are marked: No. 0, No. 1, No. 2, are the only ones likely to be of use on auto surfaces.

Rubbing Bricks are used to smooth and level down the roughstuff coats in place of pumice stone lumps nowadays. These bricks are artificially made of solid stones composed of abrasive materials similar to pumice stone. The bricks are about three by three by five inches, flat pieces are sawed off and shaped with a file for use. This material comes in three degrees of fineness and hardness. "The Fine Grain Medium" is the proper degree for rubbing lead coats, roughstuff and varnish.

The four brands listed by Chicago paint jobbers are:

Birnsstein Rubbing Bricks, No. 3-11, per cake..	\$0.15
Schumacher Fabric Rubbing Bricks, No. 3-11, per brick .....	.20
Eureka Rubbing Stone, per brick.....	.15
American Rubbing Brick, Thur-Stone, per one pound brick .....	.12

Pumice Stone. Of this material the selected lump stone is used to some extent by the auto painter. In ten to twenty-five pound lots it costs about 10c per lb. Larger quantities about 8c per lb.

Powdered Pumice is largely used with a felt rubbing pad in place of lump stone. It may be purchased from drug stores or paint stocks at about three or four cents per pound. Use the fine grade.

Rubbing Felt. For use in rubbing with powdered pumice stone only. Comes $\frac{1}{4}$ and $\frac{1}{2}$ inch thick and 18 x 18 inches square, to be cut up as needed in convenient sizes. Sold at about \$2.00 per lb.

There are various kinds of rubbing pads on the market, one of which is shown in Figure 6.

Some clean, dry cloths will be handy for wiping up the surface for examination.

A half-round file about 12 inches long is needed to square up and plane off lumps of pumice stone or rubbing brick, also to hollow out pieces to fit mouldings to be rubbed.

Pots. Some clean cans holding about a quart are needed for each of the different materials. Clean press top molasses cans are fine. For shop use the double cups with strainer shown in Figure 7 are worth their cost. One compartment carries the varnish supply and the other is to be used to wipe out the brush in after and while using. The varnish wiped off the brush usually contains grit taken from the surface. This is strained out before the wiped out varnish goes back into the large cup.

Other Tools. For washing, a good size sponge is needed; also a chamois skin or two, some clean cotton rags and two ten or twelve quart pails, one for washing water and one for rinse water.

Strainers. Metal screens are especially made for straining paint, color and varnish, but, while convenient, they are not necessary. A couple of thicknesses of cheese cloth tied over the top of a clean pot strains your material as effectively as any tool.

CHAPTER IV.

How Many Coats? Where to Paint the Car. How Much Material? Drying Conditions. The Mixing of Colors. Pigments and Liquids.

The automobile finish today is subjected to a far more destructive service, and receives less care than the carriage of former days. The slow moving carriage with its wood surface offered a much better foundation into which to anchor paint and varnish coats than the present day steel surface. The auto finish must now withstand gravel, dust and mud driven against it by the great speed of the moving car, it must stand the grease, oil and careless washing, the heat and vibration from the engine, the hot summer sun beating down upon it, driving rains, hail and snow, to say nothing of quick temperature changes caused by running the car from a warm garage in freezing weather.

These temperature changes naturally cause a considerable degree of expansion and contraction of the metal surface, and so, if the paint and varnish coats are not sufficiently elastic to expand and contract with the changes to accommodate themselves to the movements of the surface, the finish is not going to retain its beauty for long. Crazing of the varnish, the appearance of fine hair line cracks, the cracking and letting loose of the priming and ground coats soon accomplishes the destruction of the job.

The painting of an automobile, then, must be done within certain limits, in the well established way, to

insure beauty and durability, a durability such as will cause the finish to adhere to the surface without scaling off and which will resist the hard knocks to which the auto is subjected from tools, accidents, and the weather. To possess this durability the paint and varnish must attach itself firmly to the surface. The coats must be soft enough to be elastic, but hard enough to resist wear and action from the outside. If too much oil is used they will be soft and will skin off. If too little oil and too much hard drying varnish are used as binders the coats will be so hard and brittle as to chip and scale off. Usually the quickest drying coats are the least elastic, the hardest and the least durable, while coats whose thinners are proportioned to dry more slowly are more elastic, most durable and hard enough for all practical purposes. This is especially true of varnishes. The durability of the job depends upon the quality of materials, upon using coats which dry not too quickly, allowing plenty of time between coats for drying and upon the anchorage gained by the priming coat on the surface. Having all these fundamentals in mind one can the more easily see the reason for mixing the paint and varnish coats as they are specified hereinafter.

HOW MANY COATS?

Section 1.

The wood surface, because it offers paint an anchorage in its pores not given by metal, will support a far greater thickness and weight of paint and varnish than steel. It follows, then, that when painting on steel the job should be completed in as few coats as possible, consistent with producing an even, level and ample surface. The wood surface of the slow moving carriage was called upon at times to support thirty or forty coats, and it did, but such a weight of materials is wholly unnecessary on the auto surface; furthermore, it wouldn't carry it. This brings us to a consideration of the number of coats which are needed.

Before this question can be answered consideration

must be given a few others. You must first decide how much time can be allowed for the job, then how much labor, which latter means expense. The difference in material expense as between the very finest job and the quickest is not great enough to be worth figuring. You can make the method to be used fit the price you want to pay. So, you must conclude first whether you want the handsomest and most durable job which can be produced, an ordinarily nice appearing job which is quite serviceable or the quickest and cheapest job you can get and still have the car look well.

With the old and well established finishing process there is little difference in the procedure, as between the cheapest and the finest jobs, except that for the former the number of coats is decreased, the quality of the varnish and color may be lowered a little and much less labor is spent in rubbing and leveling processes to produce a perfect surface free from every blemish. For the high priced cars with the finest finish the schedule of operations would, with some slight variations by different manufacturers, proceed as below, using from eighteen to twenty-four coats.

Priming Coat:

- 6 coats Roughstuff Filler. Rub to level down.
- 6 ground coats of lead, sandpapering and puttying each as needed. Rub with pumice and water.
- 2 to 6 coats of flat color thinned with turpentine are used, light tints requiring more coats than dark colors.
- 3 to 4 coats Color Varnish rubbed as needed.
- 2 to 3 coats Rubbing Varnish.
- 2 coats Finishing Varnish.

The medium priced, but still good job, proceeds after the same general plan about like this, using ten to twelve coats in all:

Priming Coat:

- 2 to 4 coats Roughstuff Filler.
- 2 ground coats of Lead.
- 1 coat Flat Color.

- 1 coat Color with varnish.
- 1 coat Varnish with color.
- 1 coat Rubbing Varnish clear.
- 1 coat Wearing Body Varnish.

The quickest and cheapest job with this established method would use about six coats after the same plan this way:

Priming Coat:

- 1 coat Roughstuff Filler.
- 1 ground coat of Lead.
- 1 coat Flat Color.
- 1 coat Rubbing Varnish.
- 1 coat Wearing Body Varnish.

The last schedule would seem to be the least that can be expected on a new surface to give good service. It must be admitted, however, that many a business car gets nothing more than the schedule to follow and seems to get along pretty well somehow with it:

Priming Coat:

- 1 ground coat of Lead.
- 1 Color Coat.
- 1 coat Wearing Body Varnish.

With such a schedule as the last one can do no more than color the surface and protect it from rust. There is not a sufficient body of material to permit any rubbing except the very lightest going over with fine sandpaper. Without a good rubbing on roughstuff filler coats a smooth and level foundation cannot be had.

For the purpose of giving complete and specific working details it is thought best to choose by way of illustration the method for producing a first class job at a medium price. The better job is the result of an elaboration of this schedule while the cheaper one is a contraction from it. See Chapter V.

WHERE TO PAINT THE CAR.

Section 2.

The location of the car while being painted is a most important factor in determining the success of

the job. In Chapter XI will be found the complete details which go to make up proper working conditions, and these should be followed as closely as possible when painting a car anywhere outside of a regular shop. It is hopeless to expect a satisfactory, nice appearing job to come from even the best efforts when the work is done on a car located in a wood shed, stable or some such place where neither the dust, light, temperature or ventilation can be controlled. An empty store building with plaster walls, which can be made clean and kept in that condition is a good place to paint, after a heating arrangement has been made.

The car should be thoroughly washed up, inside, underside and outside before going into the shop. Place it in the shop where the light is best on the rear and both sides. Raise up high enough to permit a man to work on the under parts while in a sitting position. Four strong wood saw horses are to be placed under the car axles, one on each end. Be sure they are steady. Then remove the four wheels, the top, bumpers, tire irons, lamps, cushions and all easily detached parts, but not the fenders. With the car in this position it is ready to be cleaned and finished after the manner described in the operations to follow.

HOW MUCH MATERIAL?

Section 3.

The painter will usually buy his materials in quantity, at least in gallon cans, but the man who has but one car to finish wants to know about how much varnish, lead, color roughstuff to buy for the job. The number of coats and size of the car have some bearing on the amount of material needed, to be sure, but the list of materials to follow will name the safe quantities of each to buy for one car to avoid waste.

Red Lead, dry or ground in oil.....	12½	lb. kegs
White Lead, in oil.....	12½	lb. keg
Roughstuff	5	lbs.
Whiting, Bolted, dry, for putty.....	2	lbs.
Linseed Oil	1	quart

Turpentine	1	gallon
Japan Gold Size or Coach Japan.....	1	pint
Rubbing Varnish	½	gallon
Color Varnish	1	quart
Finish Varnish	½	gallon
Black Japan	1	quart
Enamel for wheels.....	1	quart
Colors, of each.....	2	lbs.
Powdered Pumice	1	lb.
Rubbing Bricks	1	
Sandpaper No. 0.....	6	sheets
Sandpaper No. 1.....	6	sheets
Felt for rubbing pads.....	1	sq. ft.
Two Varnish Brushes.		Clean Rags.
One Color Brush.		Cheese Cloth for strainers.
One Sponge.		One File, half round.
Two Water Pails.		Chamois Skin.
Pots.		

DRYING CONDITIONS.

Section 4.

A circulation of dry, dust-free air is what is needed more than high temperatures to facilitate the drying of paint and varnish. If an even temperature about 70° is maintained your materials will work right and dry rapidly enough, other conditions being right.

Ideal shop condition call for a work room with a steady temperature of about 70°, and a hot drying room having a temperature of from 80° to 100°, but steady at one degree or the other. When the ventilation is fair all paint, color and varnish coats dry rapidly under such conditions. The chapter about the paint shop deals more in detail with the hot drying room.

With temperature below 70° the paint coats require excessive thinning with turpentine and japan to make them brush on well, and that shortens the durability of the job, because only so much liquid can be used with the amount of pigment. When an increased quantity of turpentine is used a decreased amount of oil or varnish is used and these latter vehicles furnish the binder. Turpentine evaporates.

The very worst kind of drying conditions are those hot, muggy days in July when the atmosphere is full

of moisture. Excessive humidity at any time is an interference with proper drying. Do not soak the floor with water, by so doing you spread around moisture which will be taken up by the air and produce exactly the condition you want to avoid.

Varnish coats cannot be handled satisfactorily in temperatures below 70°, usually. Cold varnish and a cold surface cause much trouble with wrinkles, runs and sags. Keep the varnish can in a uniform temperature, not too low if you would have it brush out well and act normally on the surface.

Too much haste between coats does not permit paint, color or varnish to dry sufficiently hard. Then the different coats expand to different degrees later when the car stands in a boiling hot sun;—cracking and blistering of varnish results. The more time allowed between coats the more durable will be the job,—other things being done as well as they should be. Varnish does not possess its full power of resistance to the weather and usage until thoroughly dry and mature.

Undercoats must be absolutely dry and hard before japan color, especially lake pigments which dry quickly, are spread on to the surface. It is imperative that this rule be observed to avoid having the color and varnish coats craze and flake off. It is equally necessary in order to secure an even shade of a color all over the body. The greens in particular will show several shades and depths of color when put on over ground coats not thoroughly dry and when the color is varnished over before it has become dry.

No coat can be successfully rubbed to smooth and level up until perfectly dry.

Premature application of varnish, that is before the undercoats have had time to dry, may cause the varnish to sink in and dry with a dull, dead appearance. A surface having porous suction spots, caused by laying on too few coats, may make varnish act in the same manner.

THE MIXING OF COLORS, PIGMENTS AND LIQUIDS.

Section 5.

Japan colors as they come from the can should be thoroughly mixed and beat up with a very little turpentine, then enough turpentine may be added to thin the paste to brushing consistency. Again, thoroughly mix the turpentine with the color. Add about one-fifth or one-fourth (no more) of raw linseed oil to the mixture to help bind the color. Some brands of Japan colors are made so as to require no binder, nothing but turpentine.

On a new job the roughstuff and ground coats are more porous and absorbent than a hard old surface to be repainted, so more oil can be used to advantage on the former. About one ounce of raw linseed oil to 20 ounces of turpentine is correct for the new surface, while 1 ounce of oil to about 15 ounces of turpentine may be used on an old surface. Enough oil to produce a noticeable gloss ought never to be used, the color coats must dry dead flat. Never use any oil with Vermilion as it dulls its brilliant color. A little varnish may be used to bind it. When any color dries too quickly add just a few drops more of oil.

When you come to the mixing of two or more colors together, or making tints and shades by mixing colors or black to a white base, the utmost care is necessary to insure a very complete mixing of the different pigments together, to obtain a uniform color and to avoid dark or black streaks of color on your surface, due to failure to break up all small lumps of pigment. If your color is carefully strained through two thicknesses of cheese cloth after thoroughly mixing there can be no doubt that the pigment is ready for use.

Mix enough color at one time to finish all coats of that color. If you run short of color when half over the surface, the second batch mixed is sure to show a different shade, if not when first finished it will do

so after wearing awhile. The same may be said about mixing any material. Mix enough at once to finish the job.

Don't judge color in the pot, but brush out a little on a board to see if dark enough. Color always appears darker in the pot than when spread out. Judge color only after thoroughly mixing to make sure the tinting color already added has been taken up and shows its effect. If only partly mixed the batch will get darker later when more thorough mixing occurs, or when being brushed on it will show dark streaks.

The correct procedure in mixing any tint or shade requires that a separate clean pot be used for breaking up the white base, one for each color pigment and one into which the mixture when complete can be strained.

Start mixing the white base by adding a very little turpentine. Stir until all the turps is absorbed by the lead, then add more, a little at a time and stir in each lot, until the mixture is thin enough to brush out nicely and not too thin to cover well. This is the quickest way to prepare the white base and the only way to break up a batch and avoid having lumps in it.

Each color pigment is to be beat up, thinned and mixed in exactly the same way with turpentine and each in a separate pot.

When all have been well mixed begin adding the colors to the white cautiously and a very little at a time, stirring each dose of color into the white before adding more. Some colors are very strong. Prussian Blue, for instance, is so strong that so small an amount as one ounce will tint one hundred pounds of white to a blue tone. If you add too little you can always add more, but should too much color be put into the white a considerable amount of white must then be added to get back to the starting point. In such an event it is often quicker to discard the too dark batch and start a new one from the white rather than to make an attempt to doctor the spoiled lot.

It is the easiest thing in the world to use an overdose of japan, and an overdose of japan is a mighty

active enemy of a good paint structure.

In the rush and hurry of getting work out of the paint shop there is a strong and prevailing temptation to dope up the contents of the paint container with japan drier.

No paint when thinned with oil or turpentine, or both, should be made to carry more than 3 per cent of its volume of drying japan. When the quantity of drier exceeds this amount an element of uncertainty is added to the paint. Coach japan, it should be remembered, is compounded from a gum base and the base is a very hard drying one.

This fact alone may well cause the painter to hesitate as he adds japan to his paint mixture. An excess of japan in a body of paint is a medium of great strength in undermining the durability of the job.

One way to strain varnish thoroughly is to stretch two thicknesses of cheese cloth over a large funnel, let it sag half way down the depth of the funnel. Place a wad of clean cotton about the size of your fist in the funnel before fastening the cloth over the top with a string. The cloth and cotton effectively remove all grit. The small end of the funnel should, of course, be placed in the opening of a perfectly clean can before the varnish is run into the cloth covered end.

SCHEDULE OF OPERATIONS.

A First Class Job On a New Car—Eleven Coats—Twenty Days.

SECTION 6 THE BODY.

	Operation	
Clean the Surface.....	1	
Sandpaper, No. 1½, to Roughen Up.....	2	} 1st and 2nd Days
Dust Off	6	
Priming Coat	3	
Putty	4	3rd Day
Sandpaper, No. 0.....	5	} 4th Day
Dust Off	6	
1st Coat Roughstuff Filler.....	7	
2nd Coat Roughstuff Filler.....	7	5th Day
Stain Guide Coat.....	8	} 6th Day
Rub with Artificial Brick and Water.....	9	
Wash	6	
Dust Off	6	} 7th Day
1st Coat Lead Ground.....	10	
Rub with Horse Hair.....	11	} 8th Day
Dust Off	6	
2nd Coat Lead Ground.....	10	
Knifing Lead and Glaze Putty.....	12	9th Day
Rub with Powdered Pumice and Water.....	9	} 10th Day
Wash	6	
1 Coat Japan Color with Turpentine.....	13	
Rub with Horse Hair.....	11	} 11th Day
Dust Off	6	
1 Coat Japan Color, with Varnish.....	14	
Rub with Horse Hair.....	11	} 12th and 13th Days
Dust Off	6	
1 Coat Rubbing Varnish, with Color.....	15	
Rub with Powdered Pumice and Water.....	9	} 14th and 15th Days
Wash	6	
1 Coat Rubbing Varnish, Clear.....	16	
Rub with Powdered Pumice and Water.....	9	} 16th Day
Wash	6	
Initials or Monograms.....Chapter IX	7	
1 Coat Body Varnish.....	17	17th Day
Wash	6	} 20th Day
Polish, ready for service.....	18	

CHAPTER V.

Finishing the New Car.

This chapter will deal with the finishing of the automobile from the bare metal up, not wholly according to methods used in the factory, where cars are built with quantity as a vital factor, but after the well tried and proven processes used by skilled painters in the job shops.

OPERATION No. 1.

Cleaning the Surface.

As automobile parts come from the mechanical processes of construction they are usually coated with grease and some of the forgings may still be covered to some extent with mill scales. It sometimes happens also that rust has accumulated on some parts. Put it down as being extremely important to remove every atom of rust, all of the grease and all scales. No priming coat can attach itself to a surface when these elements remain on the surface between the paint and the solid metal. The best kind of finishing in the world cannot prevent paint coats from scaling sooner or later with rust between them and the metal. Steel wool, wire brushes and emery paper are the materials needed to polish the metal surface bright, freeing it from rust and scales. Benzine washes will remove the grease.

Any dents, holes and cracks in the surface which can be filled with solder and filed down level and smooth ought to be handled that way in preference to filling with putty. No putty ever held as well as solder. The more perfect and smooth the metal surface is made the more easily it can be finished. It will require fewer coats when well finished in the metal

than if turned over to the painter with many surface blemishes.

OPERATION No. 2.

Roughen up the Surface With Sandpaper.

When a metal body has been cleaned as thoroughly as it should be to free it from rust and other surface accumulations it will possess quite a polished surface which is too smooth to permit the priming coat to gain much anchorage or hold on it. As the painters say, it has no tooth. In order to overcome this feature it is well to rub it down a little with fairly coarse sandpaper, glasspaper or emery paper, not finer than No. 1½, which will cut and roughen up the polished metal enough to let the paint attach itself in the scratches. Carefully wipe the surface free from grit and dust off, or wash as per Operation 6.

On repainting jobs the old varnish is often so hard as to offer no more anchorage to new coats than a new metal surface, especially bodies, hoods and fenders having a baked-on finish. The gloss must be removed and the surface cut up enough to let the new coats get hold. When the old varnish is cracked it must be rubbed with sandpaper, emery paper or steel wool until it has been pretty well cut away down to the color coats and until the cracks are pretty well rubbed out and the surface smoothed up. You may depend upon roughstuff and lead ground coats to fill and level up such cracks to some extent, but not on japan color or varnish color coats.

For the repainting job, upon which the old varnish shows no cracks but has simply lost its gloss, No. 1½ sandpaper is too coarse. It will scratch the surface too much to be filled and covered up by japan color and varnish color coats which are all that are necessary to refinish such a surface. The roughstuff coats can be dispensed with. The rubbing down of the old varnish should be done with powdered pumice and water, fine artificial rubbing brick, No. 0 sandpaper

or fine steel wool, according to which cuts best on each particular surface.

A touch up and varnish job, as explained later, ought not to be rubbed down with anything but pumice and water unless it is very fine steel wool, used carefully.

OPERATION No. 3.

Priming Coat—Allow 12 Hours to Dry.

The first requirement in this operation is to wipe off the surface with a cloth wet with turpentine to remove any grease from finger prints and all dust. The surface is then ready to brush on the paint.

Make sure your brush is clean. Even if new it probably is full of dust and grit. Shake it out well, then wash in benzine or turpentine. An old brush often looks clean but is not. Paint skins and grit accumulate up at the heel around the end of the bristles and refuse to be dislodged except by diligent washing first with turpentine and later with soap and warm (not hot) water. Then the brush should be laid down flat to dry before using. A new brush should **not** be soaked in water the first thing; that is, the bristles ought not to be or they will get soft and flabby. Turn the brush bristles pointing up, separate the center bristles with the fingers and pour a little water down the center only to hit the wood plug. It is this plug which needs water so it will swell and wedge the bristles in tight. A rubber set brush has no wood plug and doesn't need the water treatment. One of the quickest ways to prevent yourself from producing a really fine finish is to use an unclean brush. Don't try it. For the kind of brushes needed see Chapter III on Tools.

Priming a metal body really consists of two separate operations. Authorities differ as to the composition of the very first coat next to the cleaned metal. Some painters have good reason to prefer a coat of straight raw linseed oil brushed on, allowed to set

half an hour or so and then wiped off with a soft cloth, not too clean but just enough to leave a thin film of oil on the surface which ought to dry at least twelve hours.

Others prefer to add about one pound of white lead ground in oil to about a pint of the oil and at the same time put in a few drops of japan drier. Otherwise handle same as above.

The English automobile painter prefers, for the first primer, two parts raw linseed oil, one part japan gold size and one part turpentine. It is brushed on, allowed to set half an hour or so and then wiped off only fairly clean with a soft cotton cloth, leaving a thin film of the oil on the surface. At least twelve hours should be allowed it to dry before covering with another coat.

Another first primer of merit to be handled the same way is: Two or three parts raw linseed oil, six parts turpentine, enough red lead to stain the liquid.

There are on the market some patent metal primers which have merit, but it is doubtful if they are any better than, or as good as, the above formulae. Surely they are not as convenient to get. The second and third formulae are most convenient and probably as good as anything known.

When the drying period for this thin wiped-off primer is up make the surface free from dust and it is ready for the priming coat proper,—of lead. Use a very fine white lead, preferably Carter "Flake White" or "Coach & Car" brand. The regular grind of white lead in oil is suitable also, although these two special grinds possess some little advantage. Pure Red Lead mixed to a paste with linseed oil holds a valid claim to first place as a primer for metal. When used a little lamp black may be added to it to tone down the bright color, unless the job is to be finished in red; otherwise the red lead, after thorough mixing, may be handled in exactly the same manner as white lead.

The lead should be thinned with enough pure raw linseed oil to bind it, but not enough to cause a per-

ceptible gloss,—about $\frac{1}{4}$ oil, $\frac{1}{4}$ japan gold size or coach japan to $\frac{1}{2}$ turpentine. The total amount of the oil and turpentine liquid used with the lead paste should be sufficient to make the paint just too thin to cover or hide the surface very well.

The mixing of the lead, oil and turpentine should be thoroughly done to make it possible later to brush on this coat evenly and without brush marks. See Section 5 concerning the proper method of mixing. It is well to add just a touch of ivory black or lamp black to the white lead also, just enough to make a light gray.

Having this lead priming coat properly mixed and the surface free from dust begin to apply the paint with an Oval Varnish Brush. By laying this first coat on evenly, not too thick, without showing prominently any laps, joints and coarse brush marks considerable rubbing later can be avoided and a superior, smooth surface gained in but few coats. Hold the brush naturally and do not bear down hard upon it after the first two or three strokes required to transfer the paint to the surface. When the paint has been put on the surface spread it with light, even strokes; finishing up each section of the surface, when completely and evenly coated in, with a few strokes with the tip of the bristles. This will take out the brush marks, leaving the paint to dry smoothly. The sides of a panel or large, flat surface should be coated in before the center. Spread the paint roughly around all four sides, then cover the center and finally go over the whole stretch with the tip of the bristles to smooth up. Do not try to coat too large a surface area at one time. What you can coat with one dipping of the brush is enough, surely not a larger area than about two by two feet. Finish each little area up completely before going to the next. If you go back a few seconds later to do more smoothing upon a panel you thought finished, you will find that the paint has set and that your brush drags and roughs up the coat greatly. So you must keep off, once an area has been

left as finished. Color and varnish coats act in the same manner, so it is well to learn at the start to finish each small area while you are on it.

At least twelve hours must be allowed this coat for drying and more time is a great help.

OPERATION No. 4.

Putty—Allow 12 Hours to Dry.

With the priming coat dry enough to work over after twelve hours, the small fissures and crevices may be filled with putty to level up with the balance of the surface. Mix the putty this way:

3 parts of dry white lead, 1 part fine bolted whiting. Thin to a stiff putty consistency with half coach japan and half rubbing varnish. Knead until thoroughly mixed. Also add a little of the japan or dry color to be used.

Another putty formula for the same purpose is:

White lead in oil. Add enough dry finely bolted whiting to make a very stiff putty. Add a little rubbing varnish, a little of the japan color and a few drops of ordinary japan drier, as much coach japan as varnish is better if handy. Knead and mix thoroughly before using.

When filling very deep holes use the last mentioned formula after adding to it a little of the hair or fibre cut from the surface of an old piece of furniture plush, it will help hold the putty in place if thoroughly mixed with it. Fill deep holes only half full, let the putty dry, shrink and get hard and then fill again to the surface level.

Putty is put in place with the regular putty knife with which all are familiar. After being forced well into the crevice the top should be carefully smoothed off, leaving it level with surrounding surface.

When the putty becomes too soft and sticky, add a little more dry whiting or lead.

When it comes to making putty to fill cracks and scratches in a baked on enamel auto surface a hard drying putty is needed. It is seldom such a surface

shows any cracks, but scratches from accidents are quite common. The fenders especially are scraped and scratched. To fill these on repainting jobs mix the putty from white lead in oil, dry white lead, dry colors to make it match the old surface, a little gold size or coach japan, a few drops of linseed oil, quick rubbing varnish and whiting. Use a flexible putty knife to put the putty in place, or better yet a spatula.

OPERATION 5.

Sandpapering.

When the lead priming coat has had its full time to dry hard it should be lightly sandpapered with No. 0 paper. Rub just hard enough to cut off the dirt nibs and dust which have settled in the new paint and to smooth off any roughness from brush marks, laps and joints.

Under no circumstances should the priming or any coat be rubbed hard enough to cut through to the bare metal, thus giving rust a chance to start over night and give trouble later. Do not try to rub out the fine brush marks, the body of paint is not thick enough for that much rubbing. Take especial care to keep the sandpaper off sharp corners and edges of the surface, because it is surprisingly easy to cut through the paint to the metal on corners, edges, projections and mouldings.

Try to rub the surface evenly everywhere; that is, rub each area about the same length of time and with the same light pressure on the paper. Wrap the paper around a small block of wood having no sharp corners when sanding fairly large areas. This will help to distribute the rubbing and to avoid cutting through in small places by exerting more pressure under the fingers on the paper than between them.

To avoid breathing the dust from sandpapering which is injurious, dip the sandpaper in turpentine once in a while. It will then cut faster also.

Should the coat be cut through to the metal in spite of your care, the bare spots ought to be coated over

again with the same paint mixture immediately after the sandpapering has been finished, the surface dusted or washed, wiped and dried off.

OPERATION 6.

Washing and Dusting Off.

Such an apparently simple operation as washing the dust and grit off of a painted surface would seem to require no explanation, yet there is more than one way to wash. No operation in the whole process is more important than thorough washing. If the particles of sand from the sandpaper, the pumice stone particles from the water-rub and the paint particles cut off the surface are not completely removed before the next coat is brushed on they will gum up and rough up the coat in a way that will surely mar the finish. It is particularly necessary to remove dirt particles from cracks and crevices. The paint brush will drag them out if not washed out.

Two ten or twelve quart pails of clear water, without soap, are needed together with a good sponge and a couple of clean paint brushes. One brush should be small, a one inch size perhaps, and the other a three or four inch width.

Sponge on the water from one pail to float and wipe off as much of the surface accumulation as possible. With the small brush dislodge any loose material from the corners, mouldings, holes and such places and then with the large brush, keeping the surface wet all the time, wipe as clean as possible.

Finally use the clean water in the other pail with another clean sponge or a clean soft cloth to rinse off the surface. With a dry, soft cloth or a chamois skin wipe the surface dry. After rubbing and washing roughstuff coats, which are more porous and absorbent than varnish and lead coats, the surface ought to dry at least over night, 12 hours, before any more paint is applied. Moisture sealed up in these coats by painting over them too soon will give trouble on the finished job.

Use no soap when washing a surface to be painted or varnished. It may cause the new material to run, sag and wrinkle. Any grease accidentally put onto the surface must be wiped off **clean** with benzine or turpentine.

A sponge used in washing up an old car or any greasy surface must never be used for washing up lead, roughstuff, color or varnish coats. It cannot be washed clean enough to avoid rubbing some grease on these new coats. It is best to have a separate, clean sponge for washing newly coated surfaces.

Just before brushing on any coat of material dust off the surface with the palm of the hand to remove any lint which may have accumulated from the wiping cloths. A three or four inch absolutely clean and dry brush or duster is better and more rapid than the hand for this latter purpose. Place a few drops of linseed oil in the hand, rub the palms together and then pass the brush bristle tips over the oil. This will cause them to pick up the dust quickly when the brush is lightly passed over the surface. Allow no oil to get on the surface. A hand bellows is also an excellent tool to blow the dust and lint from a surface just before painting or varnishing.

Remember that even the smallest piece of dirt or fibre will show up ten times as large when the paint or varnish dries over it. This is another instance where a mole hill looks like a mountain.

OPERATION 7.

Roughstuff Filler—Allow 12 Hours to Dry.

To the uninitiated this name holds but little meaning. It is, however, simply trade vernacular meaning a mixture of pigments and thinners used to fill up and level surface inequalities. No other portion of the process is more important, because if a full, solid and substantial surface is not gained by the roughstuff, lead coats and rubbing before the color coats and varnish coats go on there isn't much opportunity to build it at all. The rubbing varnish coats help a little in the

leveling of the surface but not greatly. All other finishing coats are a secondary consideration to the complete filling and leveling of the surface by means of putty and roughstuff coats.

For ordinary good results on average work but a couple of coats of roughstuff are used. Finer work calls for many, sometimes a dozen or more, because these are the coats which build the fine surface. On the other hand, it must be remembered that the metal body of today is quite a smoothly finished surface before it ever comes to the painter. So, fewer coats of roughstuff are needed on a smooth surface than for a rough one. Use no more coats than are necessary to build up a well covered, dense and level surface. The elimination of but one coat makes a considerable saving of labor cost.

Several thin coats brushed on alternately;—first lengthwise of the body then crosswise, produce a very dense, compact and fine surface. Laying the coats at right angles to each other in this way gives an even distribution and uniform thickness of material. Several thin coats of roughstuff or color, are usually better than one or two thick ones, because they dry harder, brush out more smoothly and distribute the material better over the surface. When only one or two coats of roughstuff are to go on a surface, mix them a little thicker than the brushing consistency of ordinary paint.

There are many formulae for mixing roughstuff filler coats. They are quite alike, however, but with varying proportions of materials as a chief difference.

From Chapter II on Materials it will be found that roughstuff can be purchased ready to thin down with turpentine and brush on. Often it is best to buy roughstuff, mixed ready for use and save time; surely this is the course to follow where only one or two cars are being handled at a time. Those who prefer to mix their own roughstuff can do so from white lead, and an inert material called "Keystone Filler" as the pigments and rubbing varnish, coach japan and turpen-

tine as the liquids. If the pigment portion were to be nearly all Keystone Filler the coat would dry fast and rub down easily but a rather coarse and very porous, absorbent foundation would result. This would extract the binding liquid from the color coats, causing them to sink in, to give a spotty appearance. Plenty of white lead in the roughstuff causes it to dry more slowly but gives a much more elastic foundation which never will crack. It is a more durable surface, a finer and more compact one which will hold the color coats out in place and support them.

When brushing on roughstuff coats lay the material off as evenly and carefully as the finest color or varnish coats. Work the material well into all crevices or depressions if the puttying has not yet been done,—the putty is put in after the roughstuff coats rather than over the lead priming coat by some, it is largely a matter of personal choice. Care exercised in brushing on roughstuff saves labor when rubbing down later and makes generally a better surface. Do not depend too much on rubbing to make a smooth surface. Make it by careful brushing.

The brush to be used may be either the oval varnish brush or one of the other bristle brushes discussed in Chapter III on tools. Handle the brush and brushing in exactly the same manner as was prescribed for laying on the lead priming coat.

In the schedule for this job it was assumed that each roughstuff coat would be put on early in the day, and being allowed to stand until next morning, would have about twenty-four hours to dry. Twice that time would make a more durable job. Under a great shortage of time, however, two thin coats of roughstuff are often applied each day, about eight hours apart.

Some good roughstuff formulae are given below:

3 lbs. Keystone Filler, ground in Japan.

1 lb. white lead ground in oil.

Mix to a thick paste with one-half rubbing varnish and one-half coach japan. When thoroughly mixed, thin to brushing consistency with turpentine.

The above formula is often varied by using one-half Keystone Filler (2 lbs.) and one-half lead, (2 lbs). Otherwise the formula is the same. This makes a more elastic and serviceable foundation, but does not dry quite so quickly.

When several coats of roughstuff are employed to produce an extra fine and durable surface, it is usual with many painters to change the proportions of Keystone Filler and Lead as the work progresses in this manner:

1st Coat.

- 1 lb. Keystone Filler in Japan.
- 2 lb. White Lead in Oil.

2nd Coat.

- 1 $\frac{1}{4}$ lb. Keystone Filler in Japan.
- 1 $\frac{3}{4}$ lb. White Lead in Oil.

3rd Coat.

- 1 $\frac{1}{2}$ lb. Keystone Filler in Japan.
- 1 $\frac{1}{2}$ lb. White Lead in Oil.

The proportions of the liquid would not vary, about half rubbing varnish and half coach japan to mix the pigments to a thick paste. Then thin with turpentine to brushing consistency.

Whenever the Keystone Filler is used dry to make roughstuff for first class work it may be mixed in these proportions:

1st Coat.

- 2 lb. Keystone Filler, dry.
- 4 lb. White Lead ground in oil.

Mix thoroughly to heavy paste, (thick enough so the paddle does not sink into it of its own weight) with half rubbing varnish and half coach japan. Then thin to brushing consistency with turpentine.

2nd Coat.

- 2 lbs. Keystone Filler, Dry.
- 3 lbs. White Lead in Oil.

3rd Coat.

- 2 lbs. Keystone Filler.
- 2 lbs. White Lead in Oil.

Roughstuff filler coats to be used on repainting

jobs when the old paint is not removed but is simply rubbed down level and smooth ought to be mixed this way:

$\frac{1}{2}$ White Lead.

$\frac{1}{2}$ Keystone Filler.

Mix to a stiff paste with equal parts of Coach Japan and rubbing varnish. Thin the paste to brushing consistency with turpentine.

Whenever it is possible to heat the drying room to 85° or 95° two coats of roughstuff per day may be applied, one in the morning early and one late in the afternoon. Likewise two coats of color may be applied per day in the same way. A hot room will save a day or two on any job, but otherwise it possesses no great advantage over a steady even temperature of 70° or 75°.

Roughstuff coats rubbed with water and pumice and washed must be given at least twelve hours to dry. They are more porous than lead and varnish coats and soak up much water. When painted over too soon the moisture sealed up will give trouble on the finished job.

OPERATION 8.

Stain Guide Coat—Allow 2 Hours to Dry.

While rubbing with pumice stone and water, or sandpaper either for that matter, on a surface which is the same color on top as the undercoats below, it is a little difficult to know just when the whole surface area has been rubbed uniformly.

The stain guide coat does not serve any purpose except as a guide when rubbing down the roughstuff coats to a level surface. It is a quick drying, thin stain made darker than the roughstuff coats and brushed on. As portions of the surface are rubbed the stain guide coat comes off leaving the lighter colored roughstuff coats to show. The advantage of this stain is that low places in the surface show up quickly, because the flat piece of pumice stone or artificial brick used for rubbing does not touch them, but rather cuts

the stain off the high places. As you rub longer on areas showing high bare spots and low stained places, the high spots are gradually cut down and the stain on the low places are reached. When all stain has been cut away the surface is level, provided the whole area about these low places was rubbed uniformly and evenly with a good sized piece of stone or felt pad rather than to take a small piece and dig the stain out of the low places.

The formula for mixing the stain guide coat:

A little Lamp Black-in-oil, or a little Burnt Umber-in-oil, a few drops of linseed oil, turpentine, enough to make a thin stain of brushing consistency.

When you think you have rubbed the whole surface evenly look over the work and the places which have been skipped will readily show, because the stain has not yet been rubbed off of them. To the old hand at rubbing a stain is unnecessary, but it is a great help to all whose experience is limited. It can be rubbed an hour after being applied.

OPERATION 9.

Rubbing,—Pumice and Water.

All vehicle surfaces possess some unevenness and little inequalities, no matter how well the metal or wood is finished. The lead and especially the roughstuff coats fill and build up the low places on the surface, but remember also that, since these coats are brushed on with about the same thickness all over the whole surface, higher places are built up as fast as the low spots. So, the surface is about as uneven as it was before putting on these coats. The high places, however, have a great enough thickness of paint on them, after the roughstuff coats, to stand cutting down to the level of the low places. That is precisely what is to be accomplished by rubbing with pumice or artificial rubbing stone and water. The flat stone used being three or four inches square for the body is large enough to span the distance from one high point of the surface to another, bridging over the low places

without cutting them until the high places are cut away to the level of the low. The rubbing should cease when there are no more high places to cut down to the level of the low ones.

Keep in mind that the rubbing should be done over the whole surface area, and not simply on the rough places and where low places are in evidence.

When the putty has been put in place carefully and then smoothed over before drying, likewise when the roughstuff coats are as carefully brushed on as color coats to avoid laps, brush marks and fat edges, the rubbing of the roughstuff to level up, pack and make a fine surface is a simple task. But when the foundation coats have been put on in a slap dash manner, more rubbing and more careful work are required to make the right kind of a foundation to hold up the color and varnish coats.

The success and beauty of the finished surface are made or unmade right here on this point of rubbing down of the roughstuff filler coats. If it is not done with care a compact, even surface will not result. Hollow and uneven places will be in evidence when the varnish goes on.

Rubbing Tools. Tools needed for rubbing are specified in Chapter III. In addition to those described there, a ten or twelve quart pail is needed for wash water to keep the surface wet while rubbing. A sponge is handy also for putting the water on the surface.

It is largely a matter of personal preference whether you rub with powdered pumice stone on a felt rubbing pad, lump pumice stone or artificial rubbing brick dressed down with a file as later described. The author prefers the latter material for roughstuff, but the former for lead and varnish rubbing. Artificial bricks are very extensively used among expert auto painters. For the inexperienced, the felt pad and powdered pumice are probably best; they are less likely to damage the surface.

There are skilled workmen who use in place of the

stone and water a fine grade of steel wool dipped in turpentine or a light mineral oil such as the turpentine substitutes. No doubt just as fine results can be gained by rubbing with steel wool as with the stone and water when an equal amount of care is exercised and as much skill. The stain guide coat previously described, is put on before a steel wool rub, same as for the rub with other materials.

The artificial rubbing brick cuts faster and clogs up less frequently than lump pumice stone, and it has the important advantage of being a more even and uniform composition. The cutting material of which the artificial stone is made is graded and sifted to uniform size before being pressed into solid bricks, whereas the natural lump pumice stone often contains little pieces of very hard rock which scratch the surface.

For rubbing roughstuff the first time over, the medium fine grade of artificial rubbing brick is used and care must be taken to avoid cutting away too much material from off the surface. After a once over, light rub with the medium fine stone the balance of the work is done with the fine grade of the artificial stone, or with powdered pumice stone on a felt pad.

RUBBING MOULDINGS.

Section 7.

No rubbing whatever should be done until the surface is thoroughly dry. It will skin and gum up the stone when not dry enough.

The very first thing to do is to thoroughly soak the parts to be rubbed with clean water and keep them wet all during the rubbing. Use plenty of water. Rubbing a dry surface will scratch it.

All mouldings are to be rubbed first, so that if by accident the rubbing stone does slip and cut into the flat panel surface around the moulding, the damage will not be as great as if the flat panel area had already been rubbed all it could stand and had a fine finished surface. If the flat surface is scratched before it has been rubbed there is some opportunity to remove the

scratches by rubbing later.

Find a piece of lump pumice stone about as wide as the moulding to be rubbed, or cut off a piece of the artificial rubbing brick that size. Make one side flat by rubbing it on a piece of sandpaper spread flat on a board, a flat piece of sandstone or the flat side of a file. Then with the convex side of the half-round file hollow out the flat side of the stone just planed down until it fits the moulding to be rubbed.

Soak the rubbing stone awhile and wet the moulding thoroughly with the sponge soaked in water. Begin rubbing lightly and evenly with the stone, taking care not to let the lower edge scrape the flat panel surface alongside and cut through the roughstuff to the bare metal. Rub evenly and not too hard, but just enough to smooth and level up the surface. When this much has been accomplished, stop. Great care must be exercised while rubbing to avoid cutting through the roughstuff to the bare metal anywhere, and especially on corners, edges and such sharp places where the damage is done before one realizes that he has been rubbing too hard or too long in one place.

Any places made bare by rubbing through the roughstuff and lead coats must be touched up the same day with a little shellac and some of the lead primer followed by roughstuff coats until the spot is again level, when it may be rubbed carefully to cut it down with the surrounding surface. If bare spots are not covered over with paint immediately rust will begin to corrode the metal. Then paint put on over the rust will probably scale off sooner or later.

RUBBING LARGE FLAT AREAS.

Section 8.

For such surfaces only perfectly flat stones of fair size, not smaller than about three by three inches, are suitable. Larger pieces yet are sometimes better for very large surfaces. The stone should never be so large as to make it awkward to handle.

Square up a piece of stone on one side and one end,

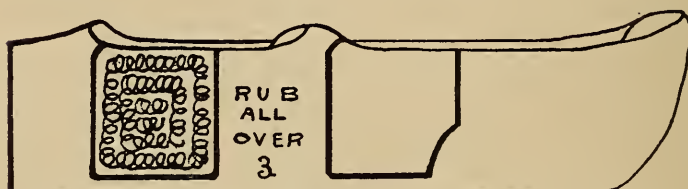
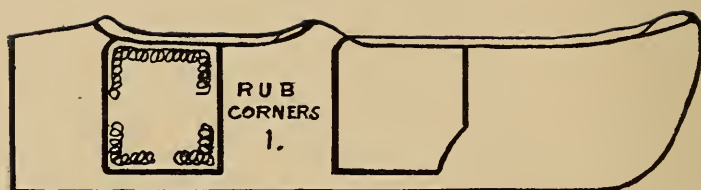


FIGURE 9

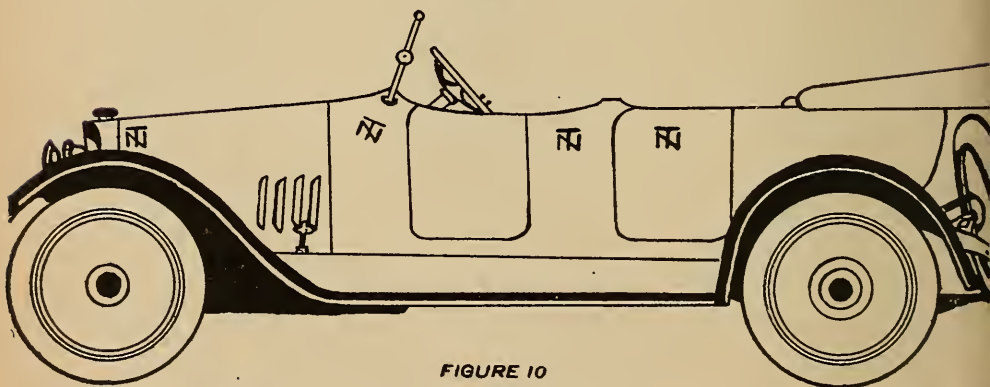


FIGURE 10

smooth off one flat side on a piece of No. 1 sandpaper placed flat on a board, a flat file will help take off the first roughness. One or more square corners are needed on the stone so it will reach the flat surface to be rubbed up next to mouldings at the corners. As long as you keep the edges of the stone fairly sharp (not a knife edge, but a square one) and the surface washed free from rubbed off material you will be able to rub the corner surfaces to a fine finish quickly.

Soak the whole stone in water a while, wet the surface and begin to rub the roughstuff in each corner of the flat panel before attempting to rub the center and larger part of the panel surface.

With all of the corner areas rubbed to a nice finish give your attention to rubbing the center surface with long strokes, exerting even pressure on the stone at all times and distribute the strokes evenly over the whole surface.

Add more water to the surface and wash the stone as often as is necessary to keep both clean and thoroughly wet.

When the stain guide coat on low places is not touched by the rubbing of the whole surface uniformly, do not tip the stone up on edge and scratch out these dark places, but keep on rubbing the high places around such spots until they are cut away by the stone held flat down on the surface. The only way to produce a perfectly level surface free from hollows and digs is to keep the stone flat down all the time. When low spots are dug out, the varnish coats emphasize the defects many times, and that mars a perfect finish.

When some places are so very low as to require excessive cutting down of the surrounding surface to level up, they had better be filled again, before the rubbing continues, with putty. Take a little of the same putty used for stopping up holes on the priming coat. Thin it down with turpentine, only enough to enable you to brush it on to the low spots smoothly. When thoroughly dry continue the rubbing as before. Usually, the roughstuff coats are thick enough all

together to stand enough rubbing to level up all shallow low places, by rubbing, without the above putty filling. That is the purpose of roughstuff coats, and if enough of them are put on to form a fairly thick foundation, they will stand as much rubbing as is necessary to remove ordinary low places.

In rubbing any flat surface move the hand in a very slightly semi-circular manner (not completely around a circle). Never rub more than a stroke or two parallel to a moulding or edge for any distance, but rather rub the surface next to the moulding with the circular motion at the same time the center of the panel is being rubbed, approaching the moulding always with a curved angle stroke. See Figure 9.

If you rub with a real small piece of stone anywhere on a flat surface, especially next to a moulding or edge, a hollow streak will show up which will be difficult to rub out later, if indeed it is possible. It may not be noticed until the varnish shows it up, then it is too late to fill it.

Remember, that rubbing too hard or too long in one place is calculated to rub through to the bare metal and you will then have to do some patching. Patching, no matter how cleverly done, is never quite as good as the original coats.

A surface being rubbed should be washed off clean often enough to keep the stone from clogging up with the material it has cut loose from the surface and the small particles which have come off of the stone itself. Otherwise the surface may be plowed up and scratched when the stone ceases to cut properly. A little powdered pumice sprinkled on the rubbing stone occasionally while rubbing helps to keep it clean and in cutting condition.

What has been said about a choked up stone plowing through a good surface and spoiling it applies just as forcefully to the use of poorly and roughly faced rubbing stones, or stones not faced at all with the file.

Keep the half round file and a piece of No. 1 sandpaper along side always when rubbing. Then see

that your stones are planed off flat and properly squared off on the edges and corners when in use. As soon as they get out of shape dress them up again on the spot, as has been said before, finishing coats, especially varnish, emphasize rather than hide scratches, hollows and streaks in the roughstuff and lead coats.

RUBBING CURVED SMALL SURFACES.

Section 9.

Fairly large curved body surfaces, engine hoods, etc., may be rubbed with the fine artificial rubbing stone same as for flat surfaces, except that the flat side must be filed and dressed down exactly to fit the curved surface to be rubbed, otherwise streaks or hollows may be rubbed in the work by the high places on the stone.

The felt rubbing pad with powdered pumice stone and water really is to be preferred for all curved surfaces, except perhaps mouldings to which it is easy to fit the stone. The felt rubbing pad is soft enough to accommodate itself to the curves of any surface.

Small surfaces had best be rubbed with the felt pad. Axles and axle housings, torc rods, drag links, springs and such curved surfaces which are small in diameter or width are best rubbed with the felt pad. On fast work they are often rubbed sufficiently with an old four inch wall brush, the bristles of which have been cut off square about two inches from the wood handle. A fairly thin soup is made of powdered pumice stone and water, the brush is dipped in and the surface is rubbed just as though it were being painted, but with more and harder strokes. The surface must be wet, as for all rubbing processes.

RUBBING LEAD GROUND COATS.

Section 10.

For the purpose of smoothing and cleaning lead ground coats up to receive the flat color coats No. 00 sandpaper or very fine steel wool are used by some, while a light pumice stone and water rub is preferred for the finest class of work. This is the last oppor-

tunity to rub the surface level and smooth, as the flat color coats to come next are not to be rubbed more than is necessary, with horse hair only, in fact, to remove dirt and lint.

RUBBING VARNISH.

Section 11.

Varnished surfaces are on the whole rubbed after the same manner as others but not so hard or long. Powdered pumice stone, a fine grade, is used on a felt pad with water, in place of lump pumice or artificial rubbing bricks.

Put onto your pad enough pumice to rub a small area and then do not put more on until that amount of surface has been rubbed to a finish, because after rubbing a few strokes the pumice on your pad becomes much finer from friction and makes a fine surface which would be scratched by adding new pumice for the same small area.

Lead, color and varnish coats should receive the minimum of rubbing, so as to leave as large a body of these materials as possible on the surface. Rub only enough to remove dirt nibs, fibres, lint, etc. The rubbing of these coats can easily be over done.

When varnish coats are properly applied, flowed on, very little rubbing is needed. The first coat of rubbing varnish can stand but a light rub, the second coat a little more, while a third coat can be rubbed pretty thoroughly, if necessary to smooth up the work. But, on the other hand, the rubbing varnish coat next under the finishing varnish ought not to be rubbed excessively with pumice, if it can be avoided. A light pumice and water rub followed by a rub or polish with rotten stone and water on a felt pad, or folded piece of old pants cloth, is the best treatment for this coat to promote a high gloss finish. The rub with rotten stone, or even dry whiting and water, cuts but little off from the surface; it packs and polishes it.

On touch up and varnish jobs, especially when only one new coat of varnish is to go on, the pumice and

water rub should be only hard and long enough to remove dirt, grease, wax from polishes and to cut the gloss of the old varnish. A light rub is enough and anything beyond that may bring to notice checks and hair line cracks which were not in evidence before.

OPERATION 10.

Lead Ground Coats. Allow 12 Hrs. to Dry.

These lead coats may be but two in number or several, according to how fine a job is being aimed at. If the roughstuff coats were mixed with a large proportion of Keystone Filler they will produce a porous surface with a strong suction, which kind of a surface requires more lead ground coats and more oil in them than when the roughstuff coats contain about half lead and half Keystone Filler.

Lead ground coats are a very necessary part of the surface as they fill up and stop the suction of the porous roughstuff coats. When a large portion of lead is used in making the roughstuff, the coats dry more slowly but with a finer, less porous and more compact surface. So then the lead coats are not so much needed, surely not more than one or two.

It is essential to stop the suction of the roughstuff coats to avoid having the later flat color coats strike into the surface in places and dry with an uneven, spotty effect.

At this point in the finishing process you have another opportunity to putty up any holes, to patch scratches and other defects in the surface.

Before spreading any of these lead coats clean off edges, and square out any corners where roughstuff may have slopped over. Cut down thick edges on door openings and such places where roughstuff accumulates excessively, so they will not chip off later after the finishing coats are on.

Before brushing on this lead coat see that the surface is thoroughly washed after the rubbing, as per Operation No. 6.

GROUND COLORS.

Section 12.

Most colors used for auto painting are semi-transparent rather than opaque like white lead, ochre and lamp black, especially are the lake color pigments transparent.

With this in mind it is obvious that a coat or two of the clear flat color will be saved if you will mix these lead ground coats with a finely ground pure white lead, such as is used for house painting, or the special pure lead called Carter Coach & Car, as a base, adding a little house paint tinting color-in-oil to the lead to make it a lighter shade of the same color as the finishing coat is to be.

If the finished color will be red, tint the white lead base to a medium dark pink by adding to it a little Tuscan Red, Indian Red or Venetian Red.

If a green finish is wanted add to the white lead base a little Medium Chrome Green in oil to produce a shade of green a few degrees lighter than the finished effect wanted.

For a blue finish Prussian Blue with a touch of Black is suitable with the lead base, or what is better is a salmon color made by adding chrome yellow, orange and a little raw sienna to the white lead base. A touch of red with medium chrome yellow will also do.

The ground coats for very light finishing colors, such as cream, ivory or the light greens and blues may be tinted about the same as the finished color wanted, but lighter. Or add just enough Medium Chrome Yellow or Raw Sienna to the white lead to make an ivory ground for all light finishing colors. Pale yellows show up best over white ground.

A very dark ground coat will cause the color coat to appear darker than it is in the can. Likewise, varnish coats darken a color a shade or two, so when planning the finished color wanted mix the lead ground color light enough, and also the flat color a little lighter than is wanted, to allow for this dark-

ening influence of ground coats and varnish coats. For ground coats for Lake Colors see Section 15.

The liquids with which to thin the lead and color pigments are chiefly turpentine and some raw linseed oil. If the roughstuff coats contained but little white lead and are quite porous make the liquid used about one-fourth raw linseed oil and three-fourths turpentine. If, on the other hand, about half white lead and half Keystone Filler were used for roughstuff, less oil will be needed. These coats should dry with a flat surface, enough oil ought never to be put in to give a gloss. A few drops of japan drier or a little coach japan are needed to assist in drying and hardening the coat.

If the first lead ground coat brushed easily, dried flat reasonably fast and hard, mix the second coat with the same proportions of lead, oil, turpentine and japan. But if the first coat dried with a noticeable gloss use less oil and more turpentine for the second coat. If it did not dry hard or soon enough a little more of the coach japan will be needed in the second coat.

When several lead coats are put on for an especially fine job, the amount of oil is decreased with each coat and the turpentine increased. Enough oil is always to be used to cause it to brush out smoothly without the stringy brush marks so noticeable when all turpentine and no oil are used as the thinner.

The mixing of these coats should be thoroughly done as per Section 5.

Brush the coats on quite thin, rub them into the roughstuff and then lay off with the tip of the brush so smoothly that brush marks, laps and joints will not show. Good brushes and care in using them will help greatly to accomplish this. See Chapter III about brushes and Operation 3 about brushing. These coats are to be brushed on as carefully as the finest color coats.

Lead coats will dry hard enough in twelve hours each to be handled. It would be quite an advantage to allow more time.

A lead ground coat to be put over old color and surface coats on repainting jobs, to fill up fine cracks, had best be mixed about like this so it will dry hard enough to sandpaper and surface well:

2 lbs. White Lead in oil.

1 lb. Keystone Filler in oil.

Mix and thin to brushing consistency with $\frac{1}{4}$ pure raw linseed oil and $\frac{3}{4}$ turpentine.

OPERATION 11.

Horse Hair Rub.

Often it is desirable to rub a surface just enough to remove dust, lint and any dirt nibs which have become lodged in the drying paint, or just enough to remove a surface gloss without cutting away any of the paint or varnish coat being rubbed.

To accomplish this secure from a furniture repairman, or from some old furniture, a few handfuls of the horse hair with which the cushions are stuffed. Automobile and buggy cushions are usually stuffed with this material also.

With a handful of hair, rub the surface fairly hard while both the hair and surface are dry.

This treatment is just what is needed to clean up the first lead ground coat before putting on the second. It is just the kind of a rub needed also after the first coat of flat color has become dry to prepare it to receive the second color coat.

The horse hair rub is good over any coat of paint or varnish when the pumice stone and water rub is not to be given. It will cut the high polish off of finishing varnish and leave a bright lustre preferred by many.

Sandpaper No. 00, or fine steel wool are sometimes used in place of horse hair if the surface is a little rough.

OPERATION 12.

Knifing Lead and Glazing Putty.

Allow at least 48 hours to dry.

If the surface is in perfect shape now, as it should

be, this operation may be eliminated from the body operations and a day can be saved.

All of the puttying was supposed to have been done for the body on top of the priming coat, but there may be a few places which were overlooked at that time. They should be attended to now as per Operation No. 4. Also some of the places puttied previously may require a second filling now to level them up properly, because the first filling sometimes shrinks.

This is the last chance to putty up defects. The next coat, the flat color, is not the proper place to putty over, although it is sometimes done after going to considerable trouble to mix putty exactly to match the color coat. Then there is a chance that the putty spots will finally finish up a little different shade than the balance of the surface.

The putty to use should be the same as before, Operation 4, but colored something like the ground coats and not so thick.

If the surface has, in spite of your best efforts, retained rough places up to this point they should now be filled with what is called knifing lead or glazing putty. Make it by adding to the putty already used, as per Operation 4, coach japan or japan gold size and rubbing varnish, equal parts. Thin with turpentine, to produce a putty just heavy enough to be put on and scraped off smooth with a broad, elastic putty knife, about three inches wide. Make the putty about as thick as flour paste or a little heavier. Spread it on to the rough places and all over the surface quite thick with the putty knife. It must be spread evenly to a uniform depth all over a rough surface. Let it dry a few minutes until it sets and takes hold of the surface. Then scrape off the putty where it is not wanted as smoothly and clean as possible with the knife, but allow it to remain in the rough places and hollows, after smoothing down nicely with the knife flat side. Let dry at least twelve hours and then rub out smooth, first with sandpaper No. 0.

Or mix the glazing putty this way:

3 parts dry white lead, or lead in oil.

1 part dry finely bolted whiting.

Mix to a stiff paste with equal parts of Coach Japan and rubbing varnish. Knead well and stain with dry colors to suit. Thin with turpentine a little, just enough to make it work smoothly under the knife.

This putty glaze is used largely on wood bodies of carriages and limousines rather than the smooth metal body where it is not often needed. Rough metal forgings and castings such as hub plates, axles and axle housings can be filled level and brought to a smooth surface quickly by using this putty on them. Hard putty such as is used on the body will not stay in place on these parts of the chassis because of the constant vibration. On curved surfaces it is easier to thin the putty a trifle more with turpentine and put it on with an old brush as thick as can be handled with that tool instead of the knife; scrape off with the knife. In fact, one without experience may find it easier to apply this putty with a brush to all surfaces.

As a means of building a surface quickly, to fill and level up so it can be rubbed smooth, glazing putty has much virtue. Several coats of the material can be knifed on and scraped off twelve hours apart.

OPERATION 13.

Japan Color Coat, with Turpentine.

Allow 12 hours to dry.

The first step to take to prepare for this coat is to inspect the surface very carefully to make sure it is thoroughly free from grit, horse hair or pieces of steel wool used for rubbing. Operation No. 6 should have left a perfectly clean surface. A wiping over with the bare palm of the hand will remove lint. See that the surface is thoroughly dry before applying this coat. Allow a day or two extra if necessary, as a dry surface after the soaking with water during the rubbing operation is sometimes hard to get. A damp surface may cause the color and varnish coats to go flat in

places and spotty.

It must be assumed that you have selected your color scheme, after reading Chapter XIV. The brushes needed are specified in Chapter III, and it pays to buy a good one. Poor brushes spoil more jobs than poor painters do. Chapter II lists and describes the japan colors to be used.

The paste color may be used the same shade as it comes in the can, after thinning and proper mixing as per Operation No. 5, or it may be made lighter by adding a little Flake White, White Lead or zinc oxide to it. The lead and zinc you can get are ground in oil, so they must be mixed with turpentine or benzine, and be allowed to settle over night or longer, when the oil which comes to the top can be drawn off and the pigment mixed with clean turpentine. If but a very small amount of the white is to be added it is not necessary to draw off the oil, but do not add any more oil to the color.

Coach, Ivory or Drop Black in japan may be added to a color to darken. But a very small amount of black can be used, however, without killing the lustre and life of a color. To darken a color it is better to add to it a darker shade of the same color. For instance, add to Light or Medium Milori Green a very little Dark Milori Green. To a red, yellow or blue which is too light add a little of a darker shade of the same color.

Any color may be made lighter or darker in the finished effect simply by making the lead ground coats very light or very dark according to which is wanted.

Any color you may select may be changed a little simply by adding a touch of some other color which it needs to improve it. If you have a yellow which is a little too much on the lemon yellow order, with a greenish cast, you may warm it up and produce a yellow with an orange tone to it simply by adding a little red,—American Vermilion. Often the gray shades mixed from black and white alone have a cold bluish cast to them. A touch of red, yellow or raw

umber makes a real improvement in them.

If you can buy the exact color wanted it is better to do so, and use it as it comes without changing its shade.

Turpentine is to be used to thin the paste color to brushing consistency. Make the color as thin as possible and yet have it cover well. The thinner it is, the more easily and evenly it can be brushed on. Thin coats dry better than thick and are to be preferred. If the coat is made too thin no harm will be done, but an extra coat will be needed to have the surface properly covered. If too thick the color will rough up and show brush marks, laps and joints excessively.

Unless you secure a brand of japan color which the manufacturer specifically says requires no binder, it is a good plan to add to the first color coat about one-fifth raw linseed oil to four-fifths turpentine when reducing the paste to brushing consistency. Most japan colors have a tendency to be a little too brittle, and without a few drops of linseed oil at least, may promote cracking later on, if the ground coats happen also to be a little too hard and inelastic. More oil than that ought never to be used, because it will produce a surface with a gloss when it should be flat to receive the varnish coats.

A second coat of flat color should have but half as much oil and the next coats still less.

Every effort should be exerted to brush these color coats on as smoothly as possible and free from laps, joints and brush marks, because but very little rubbing can be done on color coats to remove them.

Hold the brush naturally and lay the coats on as described in Operation 3 for the priming coat. Color coats set rather quickly, so it is essential that large brushes, three or four inch, be used for large surfaces. On large surfaces it is well to disregard the brushing procedure outlined as best for smaller surfaces; that is, coating in the corners of a surface first, the edges next and finally the center area. Lay the color on a

two or three foot stretch in the center of the large surface; or begin at the top side and work down, but lay the color on fast to each area two or three feet square, then go back, smooth up laps and joints with the tip of the brush and cut the edges of the color clean. Move on to the next section of the surface and coat it in the same way, taking care to join up smoothly with the color of the previous section. When color sets too fast to brush on well a few drops of raw linseed oil will slow it up enough.

It is well to flow color coats, especially lake pigments, freely on to the surface. Do not try to stretch each brushful out to see how far it will go. Make it cover a moderate amount of surface, smooth off the area nicely and then let it alone.

Blue must be handled in a different manner than other colors are sometimes used. Clear varnish spread over flat turpentine coats of color dulls and hides the pure tone of blues every time. It is desirable to add a little color to each varnish coat spread, except the finishing varnish, and it is really necessary to do so when blue is the color concerned, if you would preserve its pure tone to show in the finished surface.

Ground lead coats had best be tinted a moderately deep shade with orange chrome yellow or medium chrome yellow and a little red for most blues.

OPERATION 14.

Japan Color Coat With Varnish.

Allow 12 hours to dry.

This coat is in all respects the same as Operation 13, except that in place of a part of the turpentine a very little of the rubbing varnish is added to produce a little harder surface. Mix the varnish and a little of the turpentine together, before adding it to the color paste, then thoroughly mix all together and beat the color up fine.

OPERATION 15.

Rubbing Varnish—with Color.

Allow 48 hours to dry.

The coat mixed as per Operation 14 was chiefly color with a little varnish added. This coat is just the reverse in composition—that is, chiefly varnish, with but a little color in it. The best rubbing varnishes, considering durability and rubbing qualities most important, are quite decidedly amber, or yellow in color. This color naturally changes the tone of flat colors over which it is placed, giving them a yellowish cast. To overcome this and preserve the pure tone of the flat color coats just put on, a very small quantity of the japan color is thinned with just enough turpentine to permit it to be thoroughly mixed and beat up fine and added to the rubbing varnish. The color should be strained into the varnish through two thicknesses of cheese cloth and then stir the varnish long enough to completely take up the color. Handled in this manner, the pure tone of the color coats is not only retained but actually increases in brilliance. A decidedly better effect is gained than when clear varnish is used.

Use one to three ounces of the japan color as it comes from the can to a quart of rubbing varnish. Thin a little to brushing consistency with turpentine. This coat should be sufficiently thick to flow on after the brush like any varnish coat; that is, it cannot be stretched or brushed out to cover considerable surface, as with paint.

An extra pale varnish can be had which would not influence the color tone quite so much, but even this varnish should carry a little of the color in it. The extra pale varnishes are not generally used except for very light colors.

It is possible to secure rubbing varnish with the color already mixed with it in the correct proportion. It is called color varnish. When purchased from a reliable manufacturer this is an excellent material to use. When only a small amount is needed it is sometimes

better to buy a quart of color varnish than to spend much time mixing it, provided you can get the color wanted.

Whether a prepared color varnish is used or clear rubbing varnish to which you add japan color the varnish should be used as nearly as possible the same consistency as it comes from the sealed can.

Add no turpentine to the color varnish, or any varnish, as the manufacturers have made it of the proper consistency for brushing and to wear well. When you add the color to clear rubbing varnish use only as much turpentine as will bring the color to about the same consistency as the varnish.

When varnish has stood for some time in a can not sealed air tight it will get thick enough to require a little thinning with turpentine. If the can or pot was open enough to admit dust then the varnish, after standing in a warm room two or three days, should be strained through cheese cloth, two thicknesses, when it has been thinned with turpentine.

Any varnish which has become chilled will appear thick and sluggish, it will not brush well, the gloss will be poor and it may wrinkle and sag. Do not thin it but warm up slowly, not on a fire, but by being allowed to stand in a warm room a day or two. If you must use immediately set the can in warm water a while to warm it up very gradually. If the varnish is allowed to stand in a warm room for a week or so before it is needed it will brush just right.

It is not a wise plan to use one manufacturer's rubbing varnish, or finishing varnish, for one coat and another brand for the second coat. The two different makes possess different degrees of elasticity, and one expanding more than the other when the surface gets hot pulls against the other. Crazing or cracking may result. Likewise, it is a bad practice to mix different kinds of the same brand together,—rubbing and finishing, for instance, or two different brands of the same kind of varnish. Well known and reliable varnish manufacturers make each kind of varnish ex-

actly to fit its purpose, they are better able to temper it as to elasticity and hardness, to make it thick or thin as conditions require than the most experienced of painters. Follow the manufacturer's instructions as to the use of varnish. They are as interested as you are in having a good job result from your efforts.

In spite of the manufacturer's best efforts the best of new varnish sometimes contains enough grit or sediment to disfigure a fine surface. As a matter of caution, therefore, strain the varnish through cheese cloth into the pot or cup from which it is to be used, making certain first that the cup is perfectly clean.

When the surface has become thoroughly dry after the washing Operation No. 6, it will probably hold a little lint. Wipe this off with the bare palm of the hand, a chamois skin or a piece of silk just before the varnishing begins. A brush duster with the bristle ends slightly wet with linseed oil from the fingers will pick up dust nicely when lightly passed over the surface. Put no oil on the surface.

A surprising amount of grit, skins and all such substances as will surely mar an otherwise fine job of finishing is usually found in brushes used before. Even new brushes contain much dust, short hairs, loose bristles and such. Shake out these substances as best you can and then wash the brushes thoroughly in clean benzine, gasoline or turpentine, working the liquid well through the bristles up where they join the handle.

The brushes needed are listed in Chapter III. Some prefer a $2\frac{1}{2}$ inch brush and a $\frac{3}{4}$ inch rather than the larger ones named. Good clean chamois skins and fleece wool sponges are worth their cost for washing and cleaning of surfaces to be varnished.

The matter of absolute cleanliness with everything which has to do with varnishing is the very first law to be observed. Good materials, tools and surfaces will never produce a fine finished job unless this law is observed. As important as clean surfaces and clean brushes are of themselves, they do not succeed

unless supplemented by clean surroundings, clean hands and clothes, clean dustless floors and walls together with clean working habits. Washing and wiping up of dust is one way to keep the varnish room clean, a vacuum cleaner is better yet.

FLOWING ON VARNISH.

Section 13.

Assuming that clean, strained varnish has just been put into a clean pot, that the brushes are clean, the surface clean and that the temperature is about 70° or a little over, the next step, after seeing that all windows and doors through which dust may blow in are closed, is to work the brush into the varnish. Dip in and wipe out the varnish on the side of the pot, and then repeat several times until the varnish is completely worked through the brush.

Because one has learned how to brush on paint, it does not follow that he can for that reason lay on varnish coats well. The two operations are quite different as to handling the brush. When you spread paint you try to stretch or brush it out as far as possible and still hide the surface. Only a little paint is put into the brush and that is carefully brushed out before taking up more. When varnishing the brush is carried from the pot quite as full of material as possible and it is flowed on, leaving a thick coating to level up itself, not so thick that it will run, but much thicker than paint. Because varnish sets quickly it must be put in the proper place and spread to an even depth quickly. To go back a little while after finishing a panel to touch up sags and laps roughens up the varnish, so each area must be finished while you are on it.

For body parts of the auto surface about the same procedure is followed when flowing on varnish as when painting; that is, mouldings first, then corners of panels, sides of panels and finally centers of panels. Large surface areas, however, are handled to best advantage often with a little different procedure as to the order of parts finished first.

In coating the body, for instance, start at the front

right hand side next to the dash and coat in a space of about two feet toward the rear. Put onto this small surface immediately about all the varnish you will need to finish it by one or two helpings from the pot, taking a brush full and smearing it in the center of the panel. Of course, it will run, but you can catch it up with the brush in a minute. Now wipe your brush out evenly and begin at the top of the panel to spread, or rather, flow the varnish on downward with an even pressure of the brush to insure a uniform thickness of the coat and a level surface. Draw the brush down to about the center of the panel and then lift it clear of the work. Take up a little more varnish on the brush from the center of the panel and spread it from the bottom margin upward to meet the downward stroke just completed. Coat in the whole panel in this manner, being careful not to let the varnish accumulate in the corners and at the edges of mouldings. When it has been spread out evenly finish up with a cross stroke at top and bottom. Never mind brush marks, the varnish will level up itself and hide them.

This method of putting into the center of the panel a lot of varnish at once and then spreading it around, is a much better one for varnish than dipping out of the pot only a brushful at a time and spreading it before taking out more, because the latter practice leaves a thick spot of varnish in each place where the new brushful was first put on, the coat is not of a uniform thickness and it sets before you can go back to pick up the thick places and spread them around. Put on too much, rather than too little, varnish. Too much can readily be worked off on to the next surface, whereas too little necessitates adding another brushful or two on top of varnish which has already begun to set and get sticky. In this way the coating will be a thick and thin one, because the last varnish added will not flow out with the first as freely as it should.

In brushing on varnish cross strokes are more nearly justified than when working out paint, especially on the ends of panels and such places. In fact,

each surface of considerable area ought to be brushed over completely and quickly with the tip of the brush from top to bottom and then from side to side cross-wise to insure an even distribution of the varnish, taking care to wipe out your brush on the edge of the pot after you have gone over a surface completely one way and before you begin brushing in the opposite direction. This will remove from the brush any grit or fibre which may have been picked up from the surface.

Keep in mind that varnish is to be put onto the proper place with an even thickness of film all over the surface, and to catch up edges not covered, with as few strokes as possible. It is easy to brush it too much,—to worry or tease it, as the painters say. Lay the varnish where you want it as quickly and evenly as possible and then let it alone. Flow varnish on freely, don't try to spread it out like paint. One coat flowed on is easily equal or superior to two coats stretched out.

When finishing off a surface enough varnish should remain to permit the brush to move freely rather than to drag and stick, but when the varnish runs after laying it off nicely with the brush too much of it remains on the surface. Wipe the brush out on the pot and then pick up a little of the excess varnish on the surface. Smooth it off again.

Don't allow an excess quantity of varnish to accumulate in corners, around bolt heads and such places, but rather wipe out your small varnish brush until it carries very little varnish and then proceed to brush out excess varnish which may have accumulated anywhere. Do this just before you have given larger surfaces the finishing touch with the tip of your brush.

When the varnish has been finally smoothed off with the finishing brush, look over it carefully for fine pieces of dirt and grit, also for bristles which may have become detached from the brush. Such imperfections can readily be removed with the point of a darning

needle or a shoemaker's awl. The end of bristles and fibres should be lifted and then pulled out with the fingers. If necessary use the small brush to smooth out these breaks in the varnish.

About five hours' drying in a properly ventilated shop at 70° will see the varnish dry enough to be dust free and in forty-eight hours dry enough to handle. In varnishing do not reverse the direction of your brush while it is in contact with the surface; lift it clear of the varnish at the end of the stroke before drawing the brush back in the opposite direction. Reversing the brush on the surface doubles up the bristle ends so as to bring out any grit which may be in the brush; and it is deposited on the surface. Look out for runs always so you may smooth them out immediately. When a run occurs pound it out level with the end of the small brush from which most of the varnish has been scraped. Holding a hot iron just over the run (not touching it) will often cause it to smooth out with the aid of the brush. It may be necessary at times to add more varnish to the surface about a run, then brush it all out well both ways, wiping out the brush often so it will remove as much of the varnish as possible after the run has been brushed out.

After varnishing avoid moving about the room rapidly and unnecessarily. Even walking across the room, moving equipment and closing doors quickly stirs up considerable dust which will settle on the fresh varnish.

Not less than 48 hours should be allowed for this varnish color coat to dry hard, and more time makes for easier rubbing and a better job.

Should slight runs or fat edges dry on this color varnish coat, in spite of your care in looking for them while brushing, you must patch them as best you can. A light, careful rub over the run when dry enough, first with pumice and water, then with rotten stone will do, if done with the idea of only cutting the run to the level of the surface and not through to the ground color. The English carriage painter uses in-

stead a piece of cuttlefish bone such as we give to canary birds to pick at. The hard shell exterior is carefully cut away with a knife, at least from one side, as it would scratch the surface. Then wet the run with water and rub easily with the soft side of the cuttlefish bone. Should the color varnish be cut through to show the filler or ground coats, touch up these places with a little of the varnish color spread thin on the finger to stain the spots and let dry.

Repeat Operation 9.

The color varnish coat just finished, after drying 48 hours or longer, is ready to be rubbed smooth and free from grit. If previous instructions have been faithfully carried out as to washing and cleanliness the surface is comparatively free from grit and dirt nibs. At any rate it is to be rubbed only enough to make it clean and smooth, never rub as long or as hard as roughstuff coats or you will cut away too much varnish. A light, evenly distributed rub will be best.

The rubbing of color varnish had best be performed with powdered pumice stone and water, using a piece of thick rubbing felt as the tool. Experienced finishers may prefer the artificial rubbing brick for rubbing varnish as well as roughstuff and lead coats, but one without much experience will get on best with powdered pumice and the rubbing felt, which is less likely to cut through the varnish accidentally.

Repeat Operation 6.

In addition to the washing method given in Operation 6 for especially fine results the varnished and rubbed surface is given a water rub by expert auto painters. The water is first flowed on generously from "a first wash pail" of clean water, using a clean fleece wool sponge which is never used for anything else, then clean water from "the second wash or rinse pail" is flowed on with a different clean sponge to float off any particles of dirt on the surface. While this water is being flowed on the surface is rubbed evenly and not very hard with a clean piece of rubbing felt soaked in water. The object of this operation is to dislodge

any fine particles of pumice which may be imbedded in the surface.

The vigorous use of the water brush (an oval paint brush or sash tool) is very necessary to remove pumice stone and grit which at times accumulates in crevices under edges of mouldings and such places. If not washed out and floated off this grit will be taken up by the varnish brush and distributed over the surface in the fresh varnish, making it feel like sandpaper.

After the thorough wash the surface may next be wiped to remove the water. For this purpose a piece of chamois skin which has been used enough to free it from lint is best. Soak it in clean water first, wring it out and wipe down the surface only fairly dry. Next wipe down with a piece of old clean dry silk and let the balance of the moisture evaporate. Do not try to rub the surface completely dry. Whenever possible allow the surface to dry off for an hour or more before applying the next coat.

OPERATION 16.

Rubbing Varnish—Clear.

Allow 48 hours to dry.

The material for this coat is the same rubbing varnish as was used on the previous coat, but minus the japan color used in that coat. Where light colors are used for the finish it is a good idea to put into the varnish a very little of the color, say one ounce to a quart of varnish, for this coat, too, just enough to offset the yellowing effect of the varnish. In fact, it will do no harm to do this in all varnish coats except the last, no matter what color is used.

Before this coat is brushed on, the surface is supposed to have been rubbed as per Operation 9, and washed as per Operation 6. Now, after you have worked your brush into the varnish, by dipping it in and wiping out on the side of the pot several times, go over the surface with a clean, dust-free duster, or use an oval varnish brush, dry. The idea is to remove

the dust on the surface which has accumulated there since the washing operation. The surface will not look dusty, but it is, even if the washing was done but half an hour before. Remember the cloud of little dust particles sailing around in sunbeams coming through an open window? The air, in spite of every precaution, is full of this dust always, so the surface must be dusted immediately before you begin to brush on the varnish.

From this point on the brushing and handling of this coat should be the same as was prescribed for all varnish coats in Operation 15.

Repeat Operation 9.

Rub with powdered pumice and water with a rubbing felt as the tool.

Repeat Operation 6.

With especial reference to extra precaution as given for washing up before the clear rubbing varnish coat.

Initials and Monograms.

At this point the surface is ready for initials, monograms or striping. See Chapter IX.

OPERATION 17.

Final Varnish Coat.

Allow 3 days to dry.

The last coat of varnish on the body ought to be of the very best quality. What is called "Body Varnish" for finishing, is the grade. When a quick job is wanted, a grade called "Quick Finishing" is the material used as the last varnish coat. When the most durable job is expected the first mentioned grade of varnish is best. It is more elastic than the quick drying and more serviceable.

Clean off the surface with a duster as before and then it is ready to coat with varnish.

The flowing on of the last varnish coat, the brushing and operation in general are exactly the same as for the varnish color coat, Operation 15, and the clear

rubbing varnish coat, Operation 16. All varnishing is at best very particular work which calls for careful, painstaking effort. The compensation for that kind of effort you will consider large, however, when you see the full, brilliant and beautiful surface produced.

The period of three days for drying mentioned in the schedule is the minimum to be allowed. A job will always wear longer and appear better when a longer drying time is allowed. The newly varnished car ought never to be put into service before the varnish is sufficiently hard and dry to be unharmed by dust, mud and road oil. Immature varnish has not the power to resist wear and general service conditions, as it will have later on when completely dry and hard.

A point to be remembered is that the varnish coats will possess a much nicer appearance a week or so after it has been on the road and has been washed once than the day it comes out of the shop. The reason for this is that the wind, road dust, friction and washing combine to remove the lint and very fine dust particles which adhere to the finished varnish while it is standing to dry.

Repeat Operation 6.

On the fourth day after the final varnish coat has been put on give a thorough washing with clean, cold water, using a clean, soft sponge.

OPERATION 18.

Polishing.

After the final wash, dry the surface with the sponge, squeezing the water out of it. Allow ten or fifteen minutes for the moisture on the surface to evaporate and then rub carefully all over with a dry, soft chamois skin until the new varnish is completely dry and shows a good polish. The car is then ready for the road.

THE HOOD AND FENDERS.

These parts of the car offer a little different problem than the body because of the excessive heat and vibration to which it is subjected. A thick body of paint is not wanted because it may blister from the heat.

Fortunately hoods and fenders are usually finished up by the mechanics with a smooth and level surface, so the roughstuff filler costs may be eliminated.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper, No. 1½, To Roughen Up.....	2	
Priming Coat	3	
Sandpaper, No. 0.....	5	} 2nd Day
Dust Off	6	
1 Coat Lead Ground.....	10	
Rub with Powdered Pumice and Water.....	9	} 3rd Day
Wash	6	
1 Coat Japan Color, with Turpentine.....	13	
Rub with Horse Hair.....	11	} 4th Day
Dust Off	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Pumice and Water.....	9	} 5th, 6th and 7th Days
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 8th Day
Polish, ready for service.....	18	

The operations numbered in the above schedule are the same as given for finishing the body with the following additions and exceptions:

Operation 10. This lead coat as used on the hood and fenders will not require as much linseed oil as when put on over roughstuff coats. Cut the amount of oil down to about one-fifth, with four-fifths turpentine.

Operation 9. Rub with powdered pumice stone and water, with the felt rubbing pad as the tool.

OPERATION 19.

Japan Color—with Finishing Varnish.

This operation is exactly the same as Operation

14, except that a little finishing or body varnish is added to the color in place of rubbing varnish. The latter dries too hard and is not elastic enough to withstand heat and the vibration of hood and fenders without cracking.

OPERATION 20.

Chassis Finishing Varnish.

Exactly the same as Operation 17, except the grade of varnish to be used. Some varnish manufacturers make a special grade of varnish called Chassis Finishing, or by some other name, which is better for hoods, radiators, fenders and mud skirts than the body finishing varnish. The latter varnish is by no means unsuited to these parts. Many finishers prefer the body varnish for all parts of the car.

When a shop is equipped with a small gasoline baking oven the auto painter can save time by baking on the hood and fender finishes. A little harder surface will be gained also. More on this subject will be found in later chapters. The baking is not exactly necessary to securing a fine and durable surface.

When these parts are to be finished in black the schedule should read this way; five coats in ten days:

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper to Roughen Up.....	2	
Priming Coat	3	
Sandpaper No. 0.....	5	} 2nd Day
Wash	6	
1 Coat Ivory or Coach Black.....	21	
Rub with Horse Hair.....	11	} 3rd and 4th Days
Dust Off	6	
1st Coat Black Japan.....	22	
Rub with Powdered Pumice and Water.....	9	} 5th and 6th Days
Wash	6	
2nd Coat Black Japan.....	22	
Rub with Powdered Pumice and Water.....	9	} 7th, 8th and 9th Days
Wash	6	
1 Coat Chassis or Body Finishing Varnish..	20	
Wash	6	} 10th Day
Polish, ready for service.....	18	

OPERATION 21.

Ivory or Coach Black.

This coat is handled the same as the flat color coats in Operation 13 in all respects, except that a black pigment is used in place of japan colors. These pigments are Ivory Black or Coach Black, ground in Japan. Thin with turpentine and brush on same as colors.

OPERATION 22.

Black Japan.

This is a varnish coat and it should be handled in all respects the same as described for varnish in Operations 15, 16 and 17. Black Japan is not transparent like other varnishes, but quite a black, opaque material which looks and works like varnish. It dries more quickly and harder than some varnishes and is quite elastic. It stands up well under both heat and vibrations when of good quality. The cheap black japans commonly sold for use on pipes and other ordinary outside work are not suitable.

THE FRAME, SPRINGS AND AXLES.

	Operation	
Clean the Surface.....	1 }	1st
Priming Coat	3 }	Day
Glazing Putty	12	2nd Day
Sandpaper	5 }	3rd
Wash	6 }	Day
If to Be Finished in Black		
1 Coat Ivory or Coach Black.....	21	3rd Day
Rub with Horse Hair.....	11 }	4th
Wash	6 }	and
1 Coat Black Japan.....	22 }	5th Days
Rub with Powdered Pumice and Water.....	9 }	
Wash	6 }	6th Day
1 Coat Chassis Finishing Varnish.....	20 }	
Wash	6 }	9th
Polish, ready for service.....	18 }	Day

If to Be Finished in Color

1 Coat Lead Ground.....	10	3rd Day
Rub with No. 0 Sandpaper.....	5	} 4th Day
Wash	6	
1 Coat Japan Color, with Turpentine.....	13	
Rub with Horse Hair.....	11	} 5th Day
Dust Off	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Horse Hair.....	11	} 6th Day
Dust Off	6	
1 Coat Rubbing Varnish with Color.....	15	
Rub with Powdered Pumice and Water.....	9	} 8th Day
Wash	6	
1 Coat Finishing Varnish.....	20	
Wash	6	} 11th Day
Polish, ready for service.....	18	

The operations included in this schedule have all been given before, so the schedule is self-explanatory and sufficient to give the correct idea about finishing these parts.

It is well to remember that such parts as frame, springs and axles are not often seen, as the fenders and mudskirts hide them from close inspection. It is useless and surely impractical to put as much time on these parts as is needed to finish them as highly as the body. Even when they are free from mud, they are located so far under other car parts that no one ever pays any attention to them. Do not take it that such parts ought not to be finished carefully at all. That would be worse than to put too much time on the chassis. Make the parts clean, fill them well, smooth up nicely and varnish. Put on enough coats to make a serviceable job, to keep the parts from rusting, but do not put in a lot of time on roughstuff filler coats and fine rubbing operations.

Hard putty as used on the body is out of place on these under parts because the constant vibration will cause it to drop out.

THE WHEELS.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper, No. 1.....	5	
Dust Off	6	
1st Lead Ground Coat, white or tinted.....	10	
Putty	4	2nd Day
Sandpaper, No. 0.....	5	} 3rd Day
Dust Off	6	
2nd Lead Ground Coat, white or tinted.....	10	
Rub with Horse Hair.....	11	} 4th Day
Dust Off	6	
3rd Lead Ground Coat, white or tinted.....	10	
Rub with Powdered Pumice.....	9	} 5th Day
Wash	6	
1 Coat Japan Color, with Turpentine.....	13	
Rub with Horse Hair.....	11	} 6th Day
Dust Off	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Horse Hair.....	11	} 7th and 8th Days
Wash	6	
1 Coat Rubbing Varnish, Clear.....	16	
Rub with Powdered Pumice.....	9	} 9th and 10th Days
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 12th Day
Polish, ready for service.....	18	

The operations in this schedule have all been explained for other parts of the car except Operation 23.

The first lead ground coat, Operation 10, should be mixed with about one-third raw linseed oil, and two-thirds turpentine as thinners. The second and third lead ground coats require less oil, about one-fourth oil to three-fourths turpentine.

OPERATION 23.

Wood Filler.

The wood parts of the wheels, the wood dash and all other wood parts to be brought up with a fine finish require filling of the pores in the wood. For

this purpose secure a small can of liquid wood filler from any paint store.

For filling wheels brush the filler on to the bare wood quite thick, allow it to stand ten minutes, or as long as the directions on the can specify, just long enough so that the filler sets but doesn't get hard, then wipe it off crosswise of the grain with a piece of machine waste or coarse cloth. Allow the filler to stand at least twelve hours before sandpapering. To fill the pores of the wood up level with the balance of the surface is all that is expected of this material, it should not cover the wood or obscure the grain.

When filling a dash or any wood to be stained, the bare wood is stained first and the filler is put on after the stain has become dry. Mix a little of the stain with the filler before using to make it the same color. The filler is wiped off and handled exactly in the same manner as when the stain is not used.

OPERATION 24.

White or Tinted Enamel.

When the wheels are to be finished pure white or with some such light tint as ivory, cream, light blue, green or gray a quick way to produce a serviceable and fine appearing job is to follow the schedule given at the beginning of this section to the point where the third lead ground coat has been put on, rubbed and washed. Then flow on two good coats of the best white enamel you can get, rubbing the first one lightly with powdered pumice and water as per Operation 9. Enamels which are suitable are listed in Chapter II on materials.

When light tints are wanted carry the work along in exactly the same way after adding to the enamel a little japan color to bring it to the tint wanted. Mix the color in a separate pot with turpentine, beat it up thoroughly, strain through cheese cloth and thoroughly stir into the enamel.

A coat of finishing varnish over the enamel will give it additional life, but it is not really necessary and its color will darken the enamel finish a trifle.

OPERATION 25.

Natural and Stained Wood Finish.

With most body colors wheels finished in the natural wood color or stained with the grain showing look very well indeed.

SCHEDULE FOR STAINED FINISH.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper No. 0.....	5	
Dust Off	6	
Stain	26	
Wood Filler and Wipe Off.....	23	} 2nd Day
Putty	4	
Sandpaper	5	} 3rd Day
Dust Off	6	
First coat chassis Finishing Varnish.....	20	
Rub with Powdered Pumice.....	9	} 5th Day
Second Coat Chassis Finishing Varnish.....	20	
Wash and polish ready for service.....	18	8th Day

SCHEDULE FOR NATURAL WOOD COLOR.

Follow last given schedule for stained finish in every detail, but eliminate the stain, Operation 26.

OPERATION 26.

Stains.

The stain to be used on wheels, dash boards and any wood to be given this finish had best be one of the alcohol or spirit stains which can be secured from most any paint store. The varnish stains are not at all suitable. The oil stains can be used. Usually two applications of the latter are needed to give a dark effect. The oil stain is brushed on, allowed to stand

half an hour or so and then is wiped off with a cloth. After about twelve hours if the color is not sufficiently dark repeat the stain coat. Oil stains are mixed from first class oil ground tinting colors, raw sienna, burnt umber, Vandyke brown for oak and walnut shades. Burnt sienna, rose pink and one of the browns are used for mahogany colors. Thin these colors with about one-third raw linseed oil and two-thirds turpentine.

Dash Boards.

This part of the car is finished in the natural or stained color after exactly the same schedule as was given for wood wheels in Operations 25 and 26 except that a fine polishing varnish is sometimes used as the last coat. It is polished by rubbing first with powdered pumice and water on a piece of felt, and then with rotten stone and sweet oil or olive oil on a piece of plush cloth. The rubbing and polishing requires an even touch, not too hard and the surface must be rubbed uniformly all over. Wash up with benzine.

CHAPTER VI.

Taking Care of the Auto Finish. Lake Color Pigments.
Finishing Engines. Painting the Car White.

The full gloss finish is wanted by most car owners. Occasionally one wants, for the sporty roadster or a gray body car, the dull, metallic lusterless finish and in the face of such a preference there seems to be but one really practical way to produce the effect, and that is to first build up a full gloss finish in exactly the same manner as if that was wanted, using the same materials. When the finishing varnish has had three or four days to dry hard, rub it down lightly and evenly with fine powdered pumice stone and water with a felt rubbing pad. Rub the same as the undercoats of rubbing varnish but not so hard.

Having finished the pumice stone rub, wash up and dry carefully. Then with a clean rubbing felt free from pumice and grit, rub or polish the surface using olive or sweet oil in place of the water and powdered rotten stone in place of the pumice stone. After a quick but thorough rub with these latter materials, wipe off the surface with clean waste and you will have a dull velvet like lustre that is indeed attractive. It is as durable as the gloss and as easy to keep clean.

There are special flat paints and flat varnishes offered for producing the dull finish but they have such disadvantages as make them impractical, to say the least. They are difficult to wash and keep clean. Furthermore, they do not afford the needed protection to initials, monograms and striping because these ornaments must be placed on top of the finishing coat in-

stead of under it, as when the body is finished in the regular way.

TAKING CARE OF THE AUTO FINISH.

Section 14

The washing of an automobile seems to most people such an exceedingly simple undertaking that a discussion of the subject here may appear unnecessary. And yet, the damage to many fine finishes caused by careless and improper washing which is to be noted in most any community indicates that many do not know how to wash a car or are very careless. In either event a short mention of what does and does not constitute careful and correct washing is sure to be helpful.

A newly painted car is said to be ready for service when the last coat of varnish is dry enough to avoid collecting dust, is without tack and can be handled. That much is true when careful service is intended, but strictly speaking, new varnish on a car does not become fully dry and mature for several weeks and for that reason any washing done should include only the use of clear, cold water, no soap and never alkali soap powders. It is entirely possible to strip off both varnish and paint coats with hot water, soap and gold dust or such soap powders when used a short time after the newly varnished car has been put into service.

The best time to remove mud from a car is when it is still wet. Whenever it is washed off avoid using a strong stream from a hose because that simply drives and beats the mud against the varnish in a way that resembles a rubbing with pumice and water. If a hose is used let it be with low pressure. Soak the mud thoroughly, let it stand awhile and then go back to it with more water later. Do not rub the varnish off with sponge or cloth until thoroughly wet through, unless you want to produce an action quite like rub-

bing the varnish with sandpaper. Wet the mud so thoroughly that it will come off without any other help if possible.

With the mud soaked and washed off pretty well the surface may be cleaned up with a soft fleece wool sponge kept thoroughly soaked in water. After a thorough rinsing wipe off the surplus water, using a clean, soft chamois skin, wet it first, then squeeze out the water. It is not necessary to wipe the surface completely dry, nor even desirable. Allow the final moisture to evaporate. Then with a soft, dry chamois rub the varnish to a polish.

When the wheels and underparts pick up grease dampen a cloth with turpentine and wipe it off, washing the spots immediately with clean, warm, (not hot) water and a touch of castile soap.

Laundry soap, any soap strong in alkali and such soap powders as gold dust, are not suitable for washing because they destroy the varnish. Neutral soaps like castile are not harmful but a lather of any soap in contact with the varnish should be avoided. When soap is necessary for removing the grease on the underparts it should be completely dissolved in warm soft water. Take a gallon of soft water, add a pound or two of castile soap and heat slowly until the soap has been completely dissolved. Then keep this soap solution handy and when the car is to be washed add about a quart of it to a gallon of soft water. After the mud has been soaked and washed off of the parts having oil and grease on them, wash with this soap water, using a soft sponge and rinse with plenty of clean warm water.

Soap should not be used on the body. It isn't necessary. Body varnishes will not stand it as well as chassis finishing varnishes. Clean soft water is effective for washing the body and the sponge should be watched to make sure it contains no particles of mud which will scratch the varnish.

Of the many preparations on the market sold for the washing of cars, to remove mud without water

there is little to say. Generally they are harmful indeed to the varnish. Any washing which does not contemplate the use of plenty of clean water had best be avoided.

Body polishes and renovators are numerous indeed. A few are good but there are ten harmful preparations to every good one. Those with a paraffine oil base designed to be used to feed the varnish and put on only after a thorough water washing are probably best. They are rubbed on and wiped off immediately, leaving no surface coating. Paraffine oil alone is quite as beneficial and much cheaper. Linseed oil is especially bad as a polish and renewer. Being a drying oil it gums up the varnish and accumulates dust. While the finish on a car is new and as long as it retains a good lustre use nothing on it but clean water. Polish with a soft clean chamois.

To allow a car to stand in the hot sun is harmful, especially newly painted cars. The varnish softens up under the heat and then dust lodges in it.

When the varnish on a car wears thin, loses its lustre and shows up the bare color coats it is cheaper to have it revarnished immediately than to let the color coats wear through, making it necessary then to renew them.

LAKE-COLOR PIGMENTS.

Section 15.

Chapter II on materials lists separate from the other colors what are called "Lake" pigments or colors. They are a great deal more expensive than other japan colors and are used only for very fine work.

The Lakes are exceedingly beautiful colors, soft, clear and bright when laid on a perfect foundation of ground coats of the proper color. This latter point is important, indeed, because the great transparency of the lakes causes them to magnify any surface defects in such a way as to make the smallest blemish appear unduly prominent.

Lakes come in unusual shades of red, purple, green and yellow. Being much finer and more transparent than other japan colors they dissolve more completely in varnish and lend their color to it without any cloudiness.

The chief advantage to be gained by using lakes is that a wonderful depth of color is to be produced on bodies of considerable surface areas—large panels. In general the lakes are to be handled about like other colors today, after a better than usual surface has been developed up to the point where it is ready for color. The old method of spending an unlimited amount of time on preparing the ground is admirable but quite too slow for this day and age. That is one reason why lake pigments are not widely used. And after all, present day methods and requirements produce jobs which are sufficiently durable for the life of the car and to suit the owner's taste.

There is but little advantage to be had by using lake colors and paying a greater price for them unless enough more coats will be used to bring out their beauty and utilize their virtues. At least two more coats of varnish are needed to accomplish this than are used on the average job where ordinary colors are used. For a good job using ordinary japan colors, a coat or two of the color thinned only with turpentine to dry flat would be put on over the lead ground coats. Then a coat of the color chiefly with a little varnish would come next, followed by a coat of rubbing varnish chiefly, with a little color and finally by clear finishing varnish.

Now with lake colors the procedure would be a little different. The first color coat thinned with turpentine would be put on as described, but the next coat instead of being chiefly color and a little varnish would be a glaze coat composed chiefly of varnish with but little color in it. From the lead ground coats up the two different methods would proceed about like this:

Using Ordinary Japan Colors.

- 1 flat coat color and turpentine.
- 1 coat color with a little varnish added to it.
- 1 coat elastic rubbing varnish with a little color added to it.
- 1 coat clear rubbing varnish.
- 1 coat clear finishing varnish.

Using Lake Colors.

- 1 flat coat lake color and turpentine.
- 1 glaze coat, elastic rubbing varnish with 1 oz. lake color added to 1 pt. varnish for lighter lakes, or 2 oz. darker lake color to 1 pt. varnish.
- 1 coat same, but with only about half as much color to same amount of varnish.
- 1 coat same, but with only $\frac{1}{4}$ oz. lake color to 1 pt. of varnish.
- 1 coat same as last one.
- 1 coat clear finishing varnish.

A total of several varnish coats are especially desirable with lake colors. When well protected with varnish they hold their color and are indeed serviceable. These rubbing varnish coats with color in them are but little thinner than straight varnish coats are used and they are flowed on quite as full and freely. The lake color is, of course, thoroughly beat up and dissolved in turpentine before being mixed with the varnish.

For the most part the lead ground coats over which the turpentine flat lake color is placed should be about the same color as the lake pigment; but, of course, mixed from cheaper colors. For instance, the ground coats for expensive Scarlet Lake would be largely American Vermillion or Tuscan Red and orange chrome yellow; for Purple Lake use Ivory Black, Burnt Umber or Van Dyke Brown as a ground color; for Maroon or Munich Lakes, the ground may be a wine color not very dark, the ground for Carmine or Crimson Lake may be American Vermillion, wine

color or one of the shades of red between the two produced with Indian or Tuscan Red. The depth of color of the ground coats has a greater influence in determining the finished color when lake pigments are used than with the use of ordinary japan colors, because of the greater transparency of the former. If you want to see the real color of the lake pigment show up in the finish, make your ground coats a trifle lighter than the lake, but if a great depth of color of uncertain hue is expected the ground coats are to be about as dark as the lake color used. The great depth of color on lake painted bodies is an attraction indeed. At first glance it appears quite black, then one isn't sure whether it is purple, wine, green or what, but is certain it is not black, but beautiful above all.

Whenever as much time and skill, which means expense, as are needed to produce, with lake colors, the really fine color effects of which they are capable cannot be afforded, a job of marked beauty may still be had at less expense by following the exact method given in Section 13 for using the ordinary japan colors. That is, by using more lake color in the first two coats of rubbing varnish, as much as three or four ounces of color to the pint of varnish, then leave out two coats of rubbing varnish. The greater clearness, transparency and lustre of the lake pigments will give you in the same number of coats and with the same method a brighter and handsomer finish.

FINISHING ENGINES.

Section 16.

This work is usually left to the mechanics, but when the painter is expected to do it, he had best remove no wires, pipe lines or fittings, unless he knows motors as well as he does paint. Most motors refuse to run unless its supply lines are connected up just so.

Clean off all grease and dirt first; and that is no small job. A grease gun with a pail of benzine, a large and small brush and plenty of clean rags are the

tools needed. Squirt the benzine onto the engine freely everywhere, but first place a pail under the lowest point of the engine pan so as to catch the benzine as it runs off. A little turpentine and kerosene in the benzine cuts faster.

With the surface clean, the best coating to apply is aluminum radiator bronze, using the usual bronzing liquid.

PAINTING THE CAR WHITE.

Section 17.

Certain kinds of automobiles are of late being finished in pure white. Some are business cars, some taxicabs, roadsters and undertakers' vehicles. In most cases the chassis, enginehood and fenders are finished in black, dark blue or green, because it is so very impractical to have these parts in white. The body from the engine hood back, the wheel spokes and wood rims are the parts finished white usually.

Obviously, to produce a pure white finish requires exceptional care to keep all coats clean, not only to avoid dust, but even finger marks on the undercoats. Aside from the necessity for absolute and exceptional cleanliness the finish is but little more difficult than color work.

Whether the car is new or an old one to be re-finished, follow the painting schedules given in Chapters V, VII and VIII up to the point where the surface is ready for the coat of Japan color with turpentine. The lead ground coats should be pure white. The car is finished with two or more coats of first class white enamel. "Vitalite," the product of Pratt & Lambert, varnish makers, Chicago, is the enamel for this purpose with which the writer is most familiar. The qualities necessary in such an enamel are durability, hard drying, the ability to flow out level and to withstand rubbing with pumice and water. The cheap house enamels are not satisfactory, none but the best will do.

The first enamel coat may be thinned a little with turpentine, and if three coats are to be put on, the second coat also had best be reduced a little the same way. The last coat should be applied as it comes in the can.

Each coat should be rubbed lightly with powdered pumice and water, just enough to remove dirt nibs and the high gloss, as per Operation 9. When a dull finish is wanted rub the last coat with fine pumice stone powder, first on a felt pad with olive or sweet oil very lightly and uniformly, then polish with rotten stone and oil on a piece of plush cloth. Clean up with benzine.

The enamel is to be handled like varnish as concerns the brushing. Lay on a full, flowing coat using a soft varnish brush. Do not attempt to stretch or spread out to cover considerable surface. After coating in a surface but a foot or two square, lay it off smoothly with light strokes of the brush once in each direction; that is, lay off lengthwise of the car once and then up and down, after which the enamel must be let alone so it may flow together and level up. Watch the material carefully. If it runs, sags and folds over itself, too much has been put on. Wipe out your brush and pick up the sags immediately before the material sets.

Allow at least 48 hours to dry; a longer time for each coat would improve the finish by making it more durable. Do not try to rub an enamel coat sooner than 48 hours after applying.

Over two coats of enamel a finishing coat of pale auto varnish may be substituted for the third enamel coat, if preferred. A little of the enamel should be added to the varnish to offset its amber color.

Just before the car goes into service after drying, wash with cold water. Wash again after a week or so on the road, and the surface will look better than when it came out of the shop. There is usually a small amount of lint and fine fibres adhering to new varnish and these become washed and worn off by the wind.

CHAPTER VII.

A Quick Job—New Cars.

For various reasons quick and inexpensive jobs are in demand, even though it is quite generally known that they are not good for as long service on the road as jobs resulting from the slower surfacing and drying operations. Apparently the quick jobs are serviceable enough for some purposes, so probably we shall always have the demand for them. Read Chapter XIII about flowing on paint and varnish as a quick method.

As has been stated before in this book, the saving in time and expense which produces the quick job ought to be made by eliminating some of the coats and surfacing operations (which saves labor cost) rather than by using cheap material. There are jobs where cheap materials may be justified, but not many, considering that often it costs more in labor to apply them than for first class goods. The cost of materials for finishing the average car is small indeed as compared to the labor cost, and for that reason if the materials were cheapened by fifty per cent but two to four dollars at the most would be saved.

The use of quick drying rubbing varnish and finishing varnish, made especially for quick jobs by all varnish manufacturers, is quite necessary to effecting a saving in time. They dry more quickly and harder than the regular varnishes; they are not so elastic, which means not so durable. It is important to secure good quality in these varnishes.

A drying room heated to and maintained at a steady temperature of 85° to 95°, and with good ventilation, for all coats will save about one day of the required time for finishing. The schedules of operations to follow are based on the use of such a drying room.

A quick job can be accomplished with greater speed with such medium dark colors as the drabs, grays, browns and greens than with light tints. Dark colors cover and hide the surface better than light tints, although the latter do not show surface defects as prominently as dark colors and they stand road service better.

But little time can be saved on the operations which are included in the painting schedule to follow given as necessary even on quick jobs. The rubbing will require even more care and time on quick jobs than for others to produce a good surface and avoid rubbing through to the bare metal, because the same thickness of surface does not lie under the coats being rubbed, as when plenty of lead and roughstuff coats have been placed upon a surface.

All coats except those specified for late afternoon application should be applied as early in the morning as possible to gain the balance of the day for drying.

SCHEDULE OF OPERATIONS.

Eight Days—Seven Coats—A Quick Job.

Section 18.

BODY.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper No. 1½ to Roughen Up.....	2	
Priming Coat	3	
Hard Putty and Glaze Putty.....	4 and 12	2nd Day
Sandpaper No 0.....	5	} 3rd Day
Dust Off	6	
1 Coat Roughstuff Filler.....	7	
1 Coat Lead Ground.....	10	} 3rd Day Late Afternoon
Rub with Powdered Pumice and Water.....	9	
Wash	6	} 4th Day
1 Coat Japan Color—with Turpentine.....	13	

Rub—Horse Hair	11	} 4th Day Late Afternoon
Dust Off	6	
1 Coat Rub. Varnish—with color.....	15	
Rub—with Powdered Pumice and Water....	9	} 5th Day Late
Wash	6	
1 Coat Body Quick Drying Varnish.....	17	
Wash	6	} 8th Day
Polish, ready for service.....	18	

HOOD AND FENDERS.

Clean the Surface.....	1	} 1st Day
Sandpaper, No. 1½, to Roughen Up.....	2	
Priming Coat	3	
Sandpaper No. 0.....	5	} 2nd Day After- noon
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub with Horse Hair.....	11	} 3rd Day
Dust Off	6	
1 Coat Japan Color—with Finishing Varnish.	19	
Rub—with Powdered Pumice and Water... 9	9	} 4th Day After- noon
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 7th Day
Polish, ready for service.....	18	

THE FRAME, SPRINGS AND AXLES.

	Operation	
Clean the Surface.....	1	} 1st Day
Priming Coat	3	
Glazing Putty	12	2nd Day
Sandpaper No. 0.....	5	} 3rd Day
Wash	6	
If to be Finished in Black:		
1 Coat Ivory or Carriage Black.....	21	3rd Day
Rub—with Horse Hair.....	11	} 4th Day
Dust Off	6	
1 Coat Black Japan.....	22	
Rub—with Powdered Pumice.....	9	} 6th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 9th Day
Polish, ready for service.....	18	

If to be Finished in Color:

1 Coat Japan Color.....	13	3rd Day
Rub—with Horse Hair	11	} 4th Day
Wash	6	
1 Coat Japan Color—with Finishing Varnish.	19	
Rub—with Powdered Pumice and Water...	9	} 5th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 9th Day
Polish, ready for Service.....	18	

THE WHEELS.

Clean the Surface.....	1	} 1st Day
Sandpaper	5	
First Coat Lead Ground, white or tinted....	10	
Rub—with Horse Hair.....	11	} 2nd Day
Dust Off	6	
Second Coat Lead Ground, White or Tinted.	10	
Sandpaper No. 0.....	5	} 3rd Day
Dust Off	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 4th Day
Dust Off	6	
1 Coat Japan Color—with Finishing Varnish.	19	
Rub—with Powdered Pumice.....	9	} 5th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 8th Day
Polish, ready for Service	18	

THE QUICKEST JOB.

Seven Days—Five Coats.

Section 19.

The schedules just listed produce a job which can be turned out of the shop ready for the road in eight days, with seven coats, a saving of eleven days over the full complete schedule of Section 6, and of four coats of material, with the consequent saving of labor required by surfacing operations.

The schedules which follow are given as the mini-

imum number of operations and coats to turn out the quickest job possible with a good appearing surface and without the factory baking process. Except in the hands of experts, schedules with fewer coats and operations are not likely to give a satisfactory finished job.

THE BODY.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper No. 1½ to Roughen Up.....	2	
Priming Coat	3	
Hard Putty and Glaze Putty.....	4-12	2nd Day
Sandpaper No. 0.....	5	} 3rd Day
Dust Off	6	
1 Coat lead ground	10	
Rub—Powdered Pumice and Water.....	9	} 4th Day
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 5th Day
Dust Off	6	
1 Coat Body Quick Drying Varnish.....	17	
Wash	6	} 7th Day
Polish, ready for Service.....	18	

HOOD AND FENDERS.

	Operation	
Clean the Surface.....	1	} 1st Day
Sandpaper No. 1½ to Roughen Up.....	2	
Priming Coat	3	
Sandpaper No. 0.....	5	} 2nd Day
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 3rd Day
Dust Off	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 6th Day
Polish, ready for service.....	18	

THE FRAME, SPRINGS AND AXLES.

	Operation	
Clean the surface.....	1	} 1st Day
Priming Coat	3	

Sandpaper No. 0.....	5	} 2nd Day
Wash	6	

If to be Finished in Black:

1 Coat Ivory or Carriage Black.....	21	2nd Day
Rub—with Horse Hair.....	11	} 3rd Day
Wash	6	
1 Coat Black Japan.....	22	
Or 1 coat Chassis Finishing Varnish.....	20	
Wash	6	} 6th Day
Polish, ready for service.....	18	

If to be Finished in Color:

1 Coat Japan Color—with Turpentine.....	13	2nd Day
Rub—with Horse Hair	11	} 3rd Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 6th Day
Polish, ready for service.....	18	

THE WHEELS.

		Operation	
Clean the Surface.....	1	} 1st Day	
Sandpaper No. 1.....	5		
First Coat Lead Ground, white or tinted...	10		
Sandpaper No. 0.....	5	} 2nd Day	
Dust Off	6		
Second Coat Lead Ground, white or tinted..	10		
Sandpaper No. 0.....	5	} 3rd Day	
Wash	6		
1 Coat Japan Color—with turpentine.....	13		
Rub—with Horse Hair.....	11	} 4th Day	
Wash	6		
1 Coat Chassis Finishing Varnish.....	20		
Wash	6	} 7th Day	
Polish, ready for service.....	18		

CHAPTER VIII.

Refinishing Old Cars—A First Class Job. A Quick Job.

Before attempting to understand this chapter read carefully Chapter V about painting new cars. Read Chapter XIII about flowing on paint and varnish, a quick method—also Chapter XIV.

When it comes to the repainting of an automobile which has been in service some time there are as many ways to do the job as there are to finish a new car. There is, in fact, practically no difference between painting a new car from the metal up and repainting an old one after the surface of the latter has been properly prepared, except the elimination of some of the first surfacing coats and operations from the schedule, when the old paint and varnish still maintain a firm anchorage on the metal.

The determining factors when deciding upon the extent of repainting operations necessary are the time that can be given to the work, the expense and the condition of the old surface. The latter should carry the greatest weight when a durable finish is expected, although the element of time is also an important factor.

The first consideration is to place the car to be refinished in a suitable room, where the necessary conditions outlined in Chapter XI—about the paint shop—may be met. Then remove all attachments and equipment and place the car so it is handy to work at as per Chapter XI also.

OPERATION 27.

Removing Mud and Grease.

Assuming that the room in which the painting is to be done is right and that the body is properly stripped of loose parts and mounted in a workable position the next move is to wash and take off every atom of mud and grease.

A thorough water wash and scrubbing is first in order to take off the mud from the underparts as well as the body.

With the surface as clean as it can be made by this method let it dry and then go over it wherever any grease or hard dirt accumulations are to be seen with a mixture of about three parts of turpentine and one part kerosene. Use an old paint brush to soak the dirt with this liquid. Give it a little time to soak in before scraping it off. If the body should have any hard grease spots extra care must be taken when scraping them off to avoid gouging the painted surface off with the grease. A little rub with a rag having some pumice stone powder on it, and wet with the turpentine-kerosene mixture, will cut away hard grease. The same care should be exercised on the chassis. A putty knife is the tool mostly used for scraping.

Whenever the mud and grease accumulations are so hard on the axles, springs and such underparts that the turpentine-kerosene mixture will not soften and remove them, make a fairly strong wash by adding a little washing soda (sal soda) to some hot water. Swab this on to the hard spots and let stand a few minutes. A very thorough washing with clean, warm water must then be given to remove every trace of the soda, or it will soften up the old paint and shorten the life of the new.

With the surface as clean as it should now be, make a careful inspection of defects, cracks, scales, bare spots, etc., to decide how far into the varnish, the color coats or filler coats the defects extend. A magnifying glass would assist the inspection.

OPERATION 28.

Removing the Old Paint.

It becomes necessary to remove all of the old varnish and paint coats only when the surface shows cracks all over generally and which penetrate through all coats to the bare metal, or when the old paint shows a tendency to let go of the surface and scale off.

All of the old paint may be removed by using a liquid paint and varnish remover or by burning with a gasoline blow torch.

If the paint and varnish remover is used follow the directions given on the can. Use an old brush to apply it and a putty knife to scrape off the old material. Brush the liquid on, let stand a few minutes and then scrape off. When all paint has been taken off, wash up the surface well with turpentine and it is ready to patch up holes, dents, etc., before beginning the repainting.

To remove the paint and varnish with a blow torch, such as is used by plumbers and for heating soldering irons, the torch must first be warmed up so as to give a steady, moderate flame. Hold the torch about three inches away from the surface and at an angle of about forty-five degrees, just near enough to scorch and blister the paint so it will raise up off of the surface and can be scraped off with a putty knife. Run the flame along a strip of surface about one foot long and three or four inches wide slowly two or three times. When it has become heated pretty well follow the flame immediately with a wide putty knife. Hold the torch in the left hand and the putty knife in the right.

Keep far enough away from leather upholstery to avoid scorching it. When burning the surface near it hold a piece of tin between the flame and leather.

Do not heat any one place on the surface more than is necessary, because there may be under the paint dents or holes filled with solder which will melt.

From the viewpoint of cost old paint and varnish

may be more cheaply removed with the blow torch than with liquid paint and varnish remover.

There are some surfaces so hard and tough that many applications of liquid remover would be required to take it all off. Obviously, burning with a torch is the best method of removing such paint.

For removing varnish coats only when the color and surfacing coats are good and are to be painted over, undoubtedly the liquid remover is best.

A solution of caustic soda dissolved in water to which unslaked lime is added will remove paint and varnish coats. Likewise a solution made of sal soda (washing soda) dissolved in hot water and chloride of lime in water will remove the old paint and varnish. The application of 16° ammonia to varnish will remove it.

Except for factory or paint shop use these chemicals are hardly to be considered. The ammonia is a disagreeable material to handle, because of the penetrating odor. The other chemicals listed must be handled with rubber gloves and an old brush or swab, as they burn the skin and are also poisonous. The concentrated caustic soda, especially, must be handled with great care. In the shop these solutions are valuable indeed. Large tubs or vats are filled with such liquid removers, they are large enough to contain two or three fenders and many small parts like tire irons, hub plates, springs, etc., which are immersed in the liquid and allowed to stand a few hours, when all paint and varnish is completely taken off down to the bare metal without any labor expense whatever. All parts treated in this manner are to be thoroughly washed with clear water before refinishing. If any of the liquid remover were left on the parts it would dissolve the new paint as it did the old.

OPERATION 29.

Filling Holes and Cracks, Etc., Dents.

Cars which have been in service often have dents in the body which ought to be pushed out before re-

painting. After removing enough of the upholstery to get at the inside of the dent, hammer it out with a rounded off wood or lead mallet. When an ordinary hammer is used place a rounded off block of wood next to the metal before hitting it with the hammer.

Holes and cracks ought to be thoroughly scraped and cleaned out, polished bright with emery paper and then filled with solder. File the solder off level with the surface and smooth up. It is much better than putty. On refinishing jobs, all cavities of any size filled with hard putty first and then glaze putty ought to receive one or two coats of lead tinted to match the old paint and thinned with turpentine and a little linseed oil.

OPERATION 30.

Taking Off Wax Coatings.

Many of the automobile polishes used by car owners are made with a wax base. After such a preparation has been used a while quite a deposit of wax is laid on the body surface and it must be taken off.

Both paraffine and bees wax are soluble in turpentine. Soak a rag with turpentine which has been made quite warm by placing the turpentine can in hot water and rub it over the surface two or three times at intervals of about two minutes. Follow this immediately with a good rub with a dry cloth to remove the wax softened by the turpentine. When you think the wax has all been taken off, scrape the surface lightly with a knife and if any wax remains it will curl up on the knife. Fine steel wool soaked in turpentine may be used also to rub the wax off, when the car is to be given new color and varnish coats, but not on a touch-up and varnish job. The steel wool would scratch the surface too much for anything short of a color coat or color varnish coat to cover up.

Follow with a good wash with turpentine. If this doesn't remove the wax wipe off with alcohol on a cloth and finish with a rub with pumice powder and water.

OPERATION 31.

Touching Up Bare Spots.

Most cars to be repainted have a bare spot here or there where the paint has worn off or has been scraped off by accident.

The most important detail in touching up such spots is to make certain every atom of rust has been removed before any new paint goes on. Even a small amount of rust is enough to throw off paint coats put over it not long after the painting has been completed. A piece of emery cloth is the best tool to remove rust. Sandpaper will do.

When the rust has been taken off and the metal scoured bright, finish up with a piece of No. 1½ or No. 2 sandpaper to scratch the metal a little so it will offer an anchorage to the paint. A highly polished metal surface is a difficult one to make paint adhere to.

Mix a little white lead or red lead with about one-fourth raw linseed oil to three-fourths turpentine and a few drops of japan drier or coach japan. Add a bit of the correct tinting color ground in japan, to bring this lead coat to match the old paint.

Brush on about three coats of this lead, sandpapering each coat lightly with worn paper No. 0. On touch up and varnish jobs which are not to receive a coat of color, rub the last lead coat on bare spots with pumice powder and water, instead of sandpaper, which may scratch the adjoining surface. Then the spots are ready for whatever color, color varnish or surfacing coats which are to be placed on the balance of the surface.

In the case of a body which is not to receive a coat of japan color, but simply a coat each of color varnish and finishing varnish, the tinting of these lead coats to match the old finish is a more particular job. Of course, when the old color is quite dark—a blue, green or red, it is not possible to match it with lead. Put on two coats of the lead tinted fairly dark with a little of the right japan color or black and then for the third

coat use the japan color to match with turpentine as the thinner. When the spots being touched are not bare, but just scraped or scratched, best results will come from coating them with japan color in finishing varnish once or twice, omitting the lead ground and color and turpentine coats.

If you cannot get a japan color to match, it will be necessary to mix two or more of them together to get the correct shade. Should you get a blue that is a trifle too light add a touch of coach black, after thinning both a little with turpentine. If the blue is too dark, mix with it a touch of zinc or lead, preferably the former with blues. When a yellow has a greenish cast add a bit of red to warm it up. With other colors look at them carefully spread out and you can see what other color is needed to bring them to the correct tone.

Bare places along moulding or panel edges often have a few scales of paint loose about the edges. Sandpaper these off, cut down the rough edges and brighten the metal. Touch up with lead primer, and when dry fill up the cavity with glazing putty. When dry sandpaper down and coat with a lead ground coat tinted to match the old finish, or with japan color.

OLD PAINT TO BE REMOVED.

Section 20.

See Chapters IV and XI about getting the car ready to paint, the paint shop, drying conditions, etc.

Wash off mud and remove grease as per Operation 27.

Assuming that the old surface has cracked through varnish, color and filler coats and is in a generally bad condition, it is better to remove all of the old material than to paint over it. Especially is this true when the old finish has shown a general tendency to scale off in several places. See Operation 28 about removing old paint and varnish.

Fill dents and cracks with solder as per Operation 29.

Refinish the surface when finally cleared of the old material and repaired as per the schedules given in Chapter V for a first class job, or Chapter VII for a quick job.

OLD PAINT NOT TO BE REMOVED.

Nine Coats—Seventeen Days.

A First Class Job.

Section 21.

When it is desired that a car be repainted without taking off all of the old material to the metal, the chances of getting a durable job are good as long as the old paint and varnish coats have a firm hold on the metal. The varnish may have worn off pretty well and even the color coats, or there may be fairly deep cracks through varnish and color coats, but not through all surface material to the bare metal, without diminishing the possibility of producing a good job over the old finish as long as the priming and surfacing coats have a firm hold. But when the old paint and varnish coats show a general tendency to crack and scale off right down to the bare surface, no amount of repainting operations will result in a durable job without first removing the old finish completely and beginning over again from the bare metal to repaint the car as a new one.

Auto bodies finished with baked-on enamel rarely show cracks. Such abrasions as are to be noticed on them as they come to be refinished, are the result of accidents—scratches. Refinishing of cars in that condition requires no such elaborate treatment as is provided by the first schedule to follow. The second schedule is about right.

Assuming that in spite of the wornout appearance of the old finish the priming and surfacing coats are pretty good, that the color and varnish coats have cracked to some extent, the repainting operations necessary are about as below:

BODY.

Operation

Wash off Mud and Grease.....	27	} 1st Day
Sandpaper, No. 1½.....	2	
Wash	6	
Touch Up Bare Spots.....	31	
Fill Holes and Cracks, etc., Dents.....	29	
Dust Off	6	} 2nd Day
First Coat Roughstuff Filler.....	7	
Second Coat Roughstuff Filler.....	7	} 3rd Day
Stain Guide Coat.....	8	
Rub—with Artificial Brick.....	9	} 4th Day
Wash	6	
Dust Off	6	} 5th Day
1 Coat Lead Ground.....	10	
Glaze Putty Cracks and Rough Places.....	12	6th Day
Rub—with Powdered Pumice and Water.....	9	} 7th Day
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 8th Day
Dust Off	6	
1 Coat Japan Color—with Varnish.....	14	
Rub—with Horse Hair.....	11	} 9th Day
Dust Off	6	
1 Coat Rubbing Varnish—with Color.....	15	
Rub—with Powdered Pumice.....	9	} 11th Day
Wash	6	
1 Coat Rubbing Varnish—Clear.....	16	
Rub—with Powdered Pumice.....	9	} 13th Day
Wash	6	
Initials or Monograms.....	Chapter IX	
Dust Off	6	} 14th Day
1 Coat Body Varnish.....	17	
Wash	6	} 17th Day
Polish, ready for service.....	18	

On a surface showing but little cracking and checking eliminate one coat of roughstuff.

For a quick job eliminate Operations 14, 16, one coat of roughstuff and their rubbing and washing operations.

THE HOOD AND FENDERS.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Sandpaper, No. 1½.....	2	
Wash	6	
Touch Up Bare Spots	31	
Fill Holes and Cracks, etc., Dents.....	29	
Dust Off	6	} 2nd Day
1 Coat Roughstuff Filler.....	7	
Rub—with Horse Hair.....	11	} 3rd Day
Dust Off	6	
1 Coat Lead Ground.....	10	
Rub—with Powdered Pumice.....	9	} 4th Day
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 5th Day
Dust Off	6	
1 Coat Japan Color—with Finishing Varnish.	19	
Rub—with Powdered Pumice.....	9	} 6th Day
Wash	6	
1 Coat Finishing Varnish.....	20	
Wash	6	} 9th Day
Polish, ready for service.....	18	

For a quick job eliminate Operations 10, 19 and their washing and rubbing operations.

FRAME, SPRINGS AND AXLES.

	Operation	
Wash Off Mud and Grease.....	27	} 1st and 2nd Days
Sandpaper, No. 0 or 1½.....	2	
Wash	6	
Touch Up Bare Spots.....	31	
Fill Holes and Cracks, etc.....	29	
If to be Finished Black:		
1 Coat Ivory or Coach Black.....	21	2nd Day
Rub—with Horse Hair.....	11	} 3rd Day
Dust Off	6	
1 Coat Black Japan.....	22	
Rub—Powdered Pumice and Water.....	9	} 5th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	

Wash	6	} 8th Day
Polish, ready for service.....	18	

If to be Finished in Color:

1 Coat Lead Ground.....	10	2nd Day
Rub—with No. 0 Sandpaper.....	2	} 3rd Day
Dust Off	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 4th Day
Dust Off	6	
1 Coat Japan Color—with Finishing Varnish.....	19	
Rub—with Horse Hair.....	11	} 5th Day
Wash	6	
1 Coat Rubbing Varnish—with Color.....	15	
Rub—with Powdered Pumice and Water....	9	} 7th Day
Wash	6	
1 Coat Finishing Varnish.....	20	
Wash	6	} 10th Day
Polish, ready for service.....	18	

For a quick job eliminate Operations 22 or 19 and their rubbing and washing operations.

THE WHEELS.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Sandpaper, No. 0 or 1½.....	2	
Dust Off	6	
1 Coat Lead Ground, White or Tinted.....	10	
Putty	4	2nd Day
Second Coat Lead Ground, White or Tinted.....	10	3rd Day
Sandpaper, No. 0.....	5	} 4th Day
Wash	6	
1 Coat Japan Color—with Turpentine.....	13	
Rub—with Horse Hair.....	11	} 5th Day
Dust Off	6	
1 Coat Japan Color—with Finishing Varnish.....	19	
Rub—with Horse Hair.....	11	} 6th Day
Wash	6	
1 Coat Rubbing Varnish—Clear.....	16	

Rub—with Powdered Pumice.....	9	} 8th Day
Wash	6	
1 Coat Finishing Varnish.....	20	

Wash	6	} 11th Day
Polish, ready for service.....	18	

See Operation 24 about white enamel finish.

For a quick job eliminate Operations 19 and 16, and their rubbing and washing operations.

DASH BOARDS, ETC.

Wash Off Mud and Grease.....	27
Sandpaper, No. 0.....	5
Wash	6
Stain, if necessary.....	26
Sandpaper No. 0.....	5
Wash	6
Varnish with Cabinet, Polishing or Furniture Varnish.	

OLD PAINT NOT TO BE REMOVED.

Thirteen Days—Five Coats.

A Quick Job.

Section 22.

When it comes to repainting the car, the finish upon which is in good condition, except that the varnish coats have perished, leaving the color and surface coats without cracks, the operations necessary to produce a good job are few. The old surface may have a few bare spots, but it must have a firm hold on the metal surface with no tendency to scale off. It may be desired that the new color be the same as or different than the old.

THE BODY.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	2 and 9	
Wash	6	
Touch Up Bare Spots.....	31	
Fill Holes and Cracks, Dents.....	4 and 29	2nd Day
Wash	6	} 3rd Day
1 Coat Japan Color, with Turpentine.....	13	

Rub with Horse Hair.....	11	} 4th Day
Wash	6	
1 Coat Japan Color, with Varnish.....	14	
Rub with Horse Hair.....	11	} 5th Day
Wash	6	
1 Coat Rubbing Varnish, with Color.....	15	
Rub with Powdered Pumice.....	9	} 7th Day
Wash	6	
1 Coat Rubbing Varnish, Clear.....	16	
Rub with Powdered Pumice.....	9	} 9th Day
Wash	6	
Initials or Monograms.....	Chapter IX	
1 Coat Body Varnish.....	17	10th Day
Wash	6	} 13th Day
Polish, ready for service.....	18	

For a quick job eliminate Operations 14, 16 and their rubbing and washing operations.

THE HOOD AND FENDERS.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	2 and 9	
Wash	6	
Touch Up Bare Spots.....	31	
Fill Holes and Cracks, Dents.....	29	2nd Day
1 Coat Japan Color, with Turpentine.....	13	3rd Day
Rub with Horse Hair.....	11	} 4th Day
Wash	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Powdered Pumice.....	9	} 5th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 8th Day
Polish, ready for Service.....	18	

For a quick job eliminate Operations 19 and its rubbing and washing operations.

FRAME, SPRINGS AND AXLES.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	2 and 9	
Wash	6	
Touch Up Bare Spots.....	31	
Fill Holes and Cracks, etc.....	29	

If to be Finished in Black

1 Coat Ivory or Drop Black.....	21	2nd Day
Rub with Horse Hair.....	11	} 3rd Day
Wash	6	
1 Coat Black Japan.....	22	
Rub with Powdered Pumice.....	9	} 5th Day
Wash	6	
1 Coat Chassis Finishing Varnish.....	20	
Wash	6	} 8th Day
Polish, ready for service.....	18	

If to be Finished in Color

1 Coat Japan Color, with Turpentine.....	13	2nd Day
Rub with Horse Hair.....	11	} 3rd Day
Wash	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Horse Hair.....	11	} 4th Day
Wash	6	
1 Coat Rubbing Varnish, with Color.....	15	
Rub with Powdered Pumice.....	9	} 6th Day
Wash	6	
1 Coat Finishing Varnish.....	20	
Wash	6	} 9th Day
Polish, ready for service.....	18	

For a quick job eliminate Operations 22 or 19, and the washing and rubbing operations.

THE WHEELS.

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	2 and 9	
Wash	6	
1 Coat Japan Color, with Turpentine.....	13	

Rub with Horse Hair.....	11	} 2nd Day
Wash	6	
1 Coat Japan Color, with Finishing Varnish..	19	
Rub with Horse Hair.....	11	} 3rd Day
Wash	6	
1 Coat Rubbing Varnish, Clear.....	16	
Rub with Powdered Pumice.....	9	} 5th Day
Wash	6	
1 Coat Finishing Varnish.....	20	
Wash	6	} 8th Day
Polish, ready for service.....	18	
See Operation 24 about white enamel finish.		

For a quick job eliminate Operations 19, 16 and their rubbing and washing operations.

RENEWING AUTO TOPS.

Section 23.

About all that is needed to freshen up leather, imitation leather and rubber tops is a good wash with soft water warmed just enough to take the chill off. Add only a very little castile soap.

Mohair and other cloth tops need only a good brushing to remove the dust. Any other treatment is likely to injure them.

When any top, or upholstery either, shows considerable wear and a thorough cleaning does not brighten it sufficiently, the use of a good renewing preparation improves appearances greatly. There are many good leather and top dressing solutions offered by auto supply houses. They ought not to be used as long as the top and upholstery are in fair shape.

BRASS VARNISH AND LACQUER.

Section 24.

The car of today is ornamented with very little polished brass as compared with cars of a few years back. What little brass cars do display must be kept in a bright condition without polishing every day or so by coating it with one of the prepared lacquers made for the purpose, or with varnish.

The varnish treatment is usually most convenient. Finishing, or chassis finishing varnish is the proper material. Thin it with turpenitne to about the consistency of milk and coat the brass parts with it after they have been brought to a high polish. Use a soft camel hair brush for laying on the varnish, preferably an old one. One very thin coat is enough to keep the air away from the metal. Then it will remain bright.

CHAPTER IX.

Initials and Monograms.

Initials or monograms are desirable today as heretofore from the viewpoint of decoration, and they are urgently needed as a quick means of identifying one's car. Wherever crowds gather—at races, fairs, football games and in public parking places many cars of the same make and model are to be found, and unless one has some unusual piece of equipment—tire irons, tool boxes or such on the car it becomes impossible to pick out the right car at a glance. It is known that few men remember license numbers.

Colors. As decorations initials or monograms add a much needed touch of bright color to many overly sombre and monotonous color schemes. The letters cover such small areas that the brightest of harmonizing colors are best suited for their application, as they warm up and cheer up the whole appearance of the car, giving style, smartness and individuality when well done. Furthermore, initials and monograms divert attention from any minor surface defects.

Gold, copper, silver and aluminum colors in the metal leaf, bronze powder, bronze liquid and paint mixed to match these metals are suitable for initials and monograms on most any body color. Bronze powders may be purchased in many colors.

For medium to dark blue, red, green and brown body colors initial letters in cream, ivory, silver, aluminum are suitable.

Light body colors such as cream, light grays, drabs, tans and greens look exceedingly well lettered with a very deep, dark shade of green, red or some other dark harmonizing color.

The most certain way to gain color harmony is to letter a light colored body with a dark shade of the

same color. Likewise, letter a dark body color with a light tint of the body color.

Location. The location of initials permits of some choice. Usually one set of letters for each side of the car is enough, and they are most commonly placed on the upper portion of the rear doors. The center side panel between the front and rear doors, upper part, is an equally desirable location. The upper portion of the engine hood, either in the center or on the forward end, is a favorable location not so commonly used. Roadster bodies offer less choice of location. The side of the seats, the doors and the engine hood seem to be the most desirable places, although gasoline and oil tanks of the track type of roadster are utilized. See Figure 10.

Size of Letters. The size of the letters or monograms will vary from one to two inches high, with the different panel or door areas in which they are located. Cut out a rectangular piece of paper one and one-half by three inches, paste it onto the panel where the initials are to be placed and then step away ten or twelve feet to see if the proportions between the paper and panel area, or body as a whole, look right. Roughly sketch the initials on the paper with pen or pencil and you can decide more easily whether the letters would look better larger or smaller.

Designs. Initials may be and often are placed on top of the finishing varnish, but then they are never so durable, or quite so nice in appearance, as when placed on top of the last coat of rubbing varnish and under the finishing varnish which protects them.

As to securing the designs for initials and placing them on the car surface, let it be said that there are many methods.

Undoubtedly the best way to have one's initials or monograms placed on a car is to turn the job over to a competent sign painter. This is not always convenient or even possible, however, and so the methods to follow are given. With them it is not difficult to do a neat and nice appearing job, although an ex-

tremely complicated or fancy monogram may not be possible.

The first detail is to secure the design for the monogram or the letter shapes. If you are not sufficiently handy with a pencil to draw the initial letters on a piece of strong, smooth ledger paper or letter paper, from which to make a stencil, probably you will have no difficulty in finding a friend who is. Thin, strong paper is better than thick.

Another simple way to secure the letter designs is to look around for printed letters of the right size and character. Magazines—the Saturday Evening Post, newspapers, calendars and children's primary books offer plenty of opportunity to locate suitable letters. The printers' catalogues of type faces will give you practically any style or size of letter wanted. Letters which are a little decorative, fancy letters, are much to be preferred to severely plain block letters.

Making a Stencil. Having found the letters wanted, place the piece of heavy ledger or letter paper under the printed letters. Slip a piece of carbon paper between the two sheets and trace the letters on to the clean paper from which a stencil is to be cut. Of course, you will not find the two or three initials wanted placed side by side, so you will have to trace them off one at a time. Trace the first one on to the center of the clean sheet. Then before the second letter is traced rule a light pencil line across the clean sheet of paper, one at the top of the letter just traced on and the other at the bottom of the letter, as in Figure 11. Proceed then to trace the next letter or two so they will locate between the two pencil lines on the stencil sheet and the correct distance from each other.

When all letters have been traced pull the stencil sheet out and with a sharp pencil and a rule mark over the carbon lines to square them up and make a sharp outline to follow with the knife. The rule can be used only on the straight lines, so the curved and circular lines must be carefully marked over free hand.

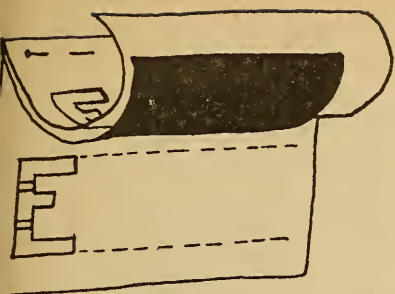


FIGURE 11



FIGURE 12

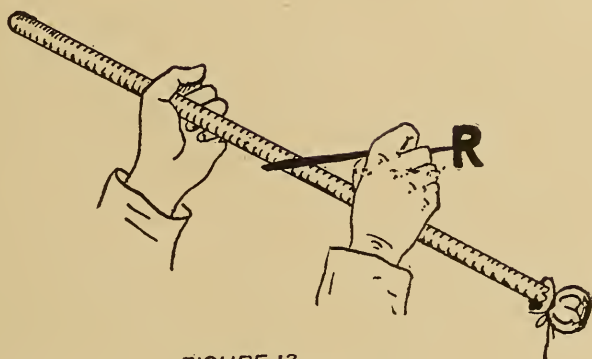


FIGURE 13

M

A
M

ATA

M
T

E.V.L.

NKS

FIGURE 14

A quicker way to outline these letters on the paper is to borrow from some brass merchant or window trimmer a set of the brass stencils which they use for making window and price tags. Draw the letter outlines on the paper with a pencil. Factory shipping departments usually have machines which cut paper stencils quickly.

With the letters clearly marked on the stencil sheet proceed to mark ties where needed to keep parts of the letter from curling up after cutting them. Do not make the ties too heavy, not wider than one-eighth inch. For instance, the center portions of such letters as "D," "O," "P," etc., would drop out unless ties were used to hold them in place. See Figure 12.

The letters traced on paper are now ready to be cut into a stencil. Coat the paper both sides with thin shellac, or paraffine wax thinned with a little turpentine. Shave a little of the wax into a tin cup, pour a little turpentine over it and place the cup in hot water. When the wax has been dissolved brush a coat of it on to the paper, or use a cloth dipped in the wax to apply it. Either wax or shellac will cause the paper to cut more easily. Place the paper on a piece of window glass (after the wax is hard or the shellac dry) and with the sharp point of a pocket knife cut through the paper, following the pencil outline of the letters, except where ties were marked off,—lift the knife when it comes to the ties, skip over the tie marks and continue on the other side. If the knife is sharp it will cut a clear, sharp edged stencil.

Put Stencil in Place. With the stencil of the initials or monograms all cut and ready the next point is to decide on where to locate it. Then take a piece of cheese cloth about six inches square, lay it flat on the bench and place three or four tablespoonfuls of dry whiting in the center. Pick up the corners of the cloth, twist them together to form a bag and tie a string around the neck. With this pounce bag pat the surface of the car where the initials are to be located so as to cover it with the fine whiting. The whiting is a

safeguard to prevent gold leaf, when used instead of bronze powder, from sticking to the varnish if the least bit tacky. Water will wash off the whiting when the job has been finished.

Now place a small spot or two of mucilage on the back of the stencil paper and place the stencil on the spot selected and covered with whiting, taking care to see that it is straight and in the exact center of the panel from side to side. Better use a rule to measure and mark off with chalk a center line up and down as well as two horizontal lines between which the stencil is to be placed.

Fill in Stencils with Bronze. The colors and materials to be used are next to be considered. There are several ways to fill in and transfer the letters after the stencil is in place.

The most simple way is to transfer the letters by filling in the stencil with a liquid gold, copper or aluminum bronze, or a mixture of them which can readily be purchased at any art or paint store. Bronze powder mixed with bronzing liquid will serve the purpose, but not quite so well unless very finely ground. Rubbing varnish thinned with turpentine to the consistency of linseed oil can be used in place of the bronzing liquid.

With bronze in a tin cup dip a small stencil brush, or a flat one-inch paint brush, into it and scrape out the bronze on the side of the cup. Repeat several times until the brush is thoroughly worked into the mixture. Then spread a little of the bronze on a board to see if it covers well. If it does not, add a little more bronze powder. Dip the brush into the mixture again, wipe it out on the cup and then on the board until it is quite dry and it is ready to work on the stencil. When the brush contains too much bronze or paint and when the paint is too thin, it will run under the stencil, making a ragged, smeary letter.

Hold the stencil down with the thumb and fingers of the left hand. It must lay flat and tight against the car surface. Take the brush with right hand and pound the cut out stencil letters with it straight up and down.

Do not try to spread the paint as on any other surface by rubbing the brush back and forth over the letters. Use the brush like a hammer—pound straight up and down until the letters are completely transferred to the surface.

Hold the stencil tight against the surface still with the left hand and lay down the brush. Take hold of the lower corner of the stencil with the right hand fingers, holding tight with the left all the time, and peel off the stencil, being careful all the time to avoid moving the paper sideways until it is clear of the newly transferred letters.

The letters ought to appear sharp and clean, without ragged edges, if this operation is well done. They will show breaks or bare spots, to be sure, where the ties were placed when cutting the stencil. These ties may now be carefully filled in with the liquid bronze before the first applied bronze becomes dry. For this purpose the soft camel hair or badger brushes used for water color painting by artists are just right. Get one with a good point and of medium size. If the letters are well covered and sharp brush the bronze only over the ties, but if not evenly covered the coat ought to be spread all over the letters completely. For use in touching up these ties and filling in the letters a handy tool is a round stick about a foot long and half an inch or so in diameter. Wrap a piece of cloth around one end so it will not scratch the car surface. Holding it off the surface with left hand, rest the right hand on it. You have probably noticed sign painters use such a stick while lettering on glass. Figure 13 illustrates the position.

Wipe off the mucilage spots with a wet cloth before they get dry.

After several hours drying the letters may be left as they are, when put on before the last varnish coat. When placed on top of the last varnish coat of a new or old car it will wear pretty well without further attention, but a coat of clear rubbing varnish, brushed on to the letters only with the small water color brush,

will keep the bronze bright for a longer period and protect it from scratches. Contact with the air is what causes bronze powder, gold leaf and such metals to tarnish. Varnish keeps the air away.

Fill in Stencil with Metal Leaf. A much better appearing job may be produced by filling in the stencil letters with metal leaf in real gold, imitation gold, silver or aluminum leaf. With gold leaf the grade known as Hastings XX is correct. It comes in very thin sheets of the metal placed between sheets of paper about three inches square. What is called Hastings' Patent or Transfer Gold may also be used. Gold leaf can now be purchased which is made fast to a sheet of paper, instead of being loose between two sheets of paper. It is the more easily handled as explained a little later. Silver Leaf is cheaper and is handled in exactly the same way as gold. Aluminum Leaf is still cheaper and can be handled more easily, because it is a little thicker and tougher. Imitation Gold Leaf sells at about the same price as silver leaf and is satisfactory for some jobs. It will tarnish sooner than real gold leaf. Prices on these metals fluctuate considerably. A paint jobbers' catalog at this writing lists them as below:

Hastings' Extra Deep Gold Leaf.....	per book	\$0.42
Hastings' Patent or Transfer Gold Leaf.....	" "	.42
Aluminum Leaf	" "	.30
Silver Leaf	" "	.30
Imitation Gold Leaf.....	" "	.30
Japan Gold Size for Metal Leaf.....	per ½ pint	.25

So small an amount of leaf is needed that you may get it from some sign painter most conveniently.

The stencil is put in place as described before and the whiting which shows through the letters is wiped off the surface. Then the letters are filled in with Japan Gold Size, a liquid made for use with metal leaf.

The stencil brush used with the bronze powder may be used in the same way to put on the gold size. Then lift the stencil as before and fill in the ties with gold size, using the small soft water color brush. If

need be, coat the letters entirely with size again, but be very careful not to get even a touch of the size on the surface anywhere except on the letters or the gold leaf will stick to the surface where you don't want it. The whiting was placed on the surface before the stencil to guard against this. Let the size stand until it gets quite sticky. This will require the time mentioned on the size can or bottle,—it may be a 24 or 48 hour gilding size.

When the size is sticky enough to hold the leaf in place the job may proceed. If ordinary metal leaf has been secured it is in loose sheets between pieces of paper in a book. Fold back the paper sheet over the first metal sheet and lay the book flat near by. Run the thumb nail across the metal leaf to crease it and cut off one-half or one-quarter of the sheet,—just enough to a little more than cover one letter. Take up a one or two inch camel hair soft brush, rub it on the head to gather static electricity from the hair, then wipe the brush across the piece of metal leaf and you can pick it up on the brush tip. Carry the leaf to the surface and lay on the first letter. Smooth it out with the brush tip, taking care not to let the brush touch any of the size and get sticky. Gold, Silver, Aluminum and Imitation Gold Leaf are all handled the same way. The leaf cannot be moved very much but by patting it with a small wad of cotton, the wrinkles can be removed and the leaf spread to completely cover the edges of the letter. The leaf should be a little larger than the letter all around, an eighth of an inch or more. If the whole letter can be covered with one piece of metal it is best, but two or more pieces may be joined up and lapped a little to cover a letter. Never mind if the edges of the leaf are very ragged, but be sure the entire surface is covered. When the leaf has been made to cover the whole letter use the cotton wad to smooth out the metal perfectly.

With all of the letters covered with leaf allow twelve hours or more for drying. Then a rub with the cotton wad will remove the loose leaf around the

letters where no size was placed and the letters will stand out well covered and clear cut. By rubbing the metal well with the cotton wad it will be polished nicely. Wash off with cold water and dry the surface. It is then ready to be varnished over. When the letters are placed on top of the last varnish coat they alone ought to be given a coat of rubbing or finishing varnish as a protection from the air which will tarnish them and from scratches.

An easier way to handle the gold leaf is to buy the kind which instead of being in flat sheets loose between two pieces of paper is pasted on to one sheet of paper. The paper and leaf attached are cut into pieces of about the right size to cover a letter or monogram and when the gold size is sticky enough the piece of paper with the gold on it is laid on the size (leaf side on to the size), the paper is smoothed out with the cotton wad and after several hours when the size has set, the paper is removed, leaving the gold leaf on the letters. The leaf remaining on the paper, if any, may be used again to touch up thin places or uncovered corners on letters. After removing the paper the leaf left on the letters should be burnished by rubbing it with the cotton wad. This will also remove any ragged edges of leaf. This kind of leaf like the other ought to be protected by a coat of varnish.

A variation of the method given for transferring the stencil letters to the surface with size on a stencil brush would be to put the stencil in place as before described. Wipe out the whiting which shows through the letters. Then sharpen a piece of ordinary white chalk and draw through the stencil the outlines of the letters on the surface. Remove the stencil and brush the gold size on to the letters between the chalk lines only, of course, as before. Use a medium size artist's water color brush. This means a little more free hand work, but it really requires more care than skill.

Fill in Stencil with Paint. The use of japan colors thinned with turpentine and enough rubbing varnish

to dry with a gloss is a simple and effective way to transfer the stencil letters or monogram to the car surface. Beat up the japan color selected with turpentine until it is very well mixed. Add the rubbing varnish, thoroughly mixing it in. Lay the color on to the surface through a stencil with a small stencil brush or a one inch paint brush just as was described for the application of the liquid bronze. Remove the stencil as described and coat in the letters with the color on a medium size camel hair water color brush to cover up the ties. If needed, lay the color over the entire surface of the letters to get an even, smooth appearance. If the color drags under the brush and gets sticky before it has been smoothed out, too much varnish has been used; add a little turpentine to the mixture. A small piece of glass is handy to use as a palette. Dip the brush into the color, carry it to the glass and then work the brush out smooth and even in the color on the glass before carrying it to the letter.

If the letters have not been placed upon the rubbing varnish coat so they will be protected by the last coat of body varnish a coat of rubbing varnish ought to be brushed on to the letters only when dry.

Glazing Colors. After placing the letters on a car as just described with bronze, gold, silver or metal leaf or japan colors a very rich effect can be gained by brushing over the letters with a very thin, transparent color mixture which will allow the gold or other color to show through.

Handle the stencil and lettering exactly as described before, but do not put on the coat of varnish over the finished letters. Instead, take a little rubbing varnish, thin it with turpentine until about as thin as linseed oil. Add a very little of the japan color selected, mix thoroughly and spread it on to the letters in a thin coat with a soft camel hair water color brush. Better test this glazing medium on some other surface than the car at first to see if it has enough color in it to be noticed. If too thick or too much color has been

put in, the gold or other color of the letters will be covered too solidly to show through. The color of the letters should show most prominently with the glazing color as a thin transparent sheen on top. A little experimenting will enable you to mix this glazing color just right.

One way to treat gold, silver, cream, ivory or other light colored letters is to place over the first initial letter a glaze of ultramarine blue or cobalt blue. Over the second letter place a glaze of verdigris green and over the third letter a glaze of vermillion, carmine or other red.

In like manner many different combinations of japan colors may be used as glazes. They are mixed so thin, that placed over gold, silver, ivory and such light grounds, they show up as light, transparent tints rather than like the deep colors they are in the can. And so practically all such very light tints harmonize with each other.

It is suggested that a practice job of transferring and filling in the initials be carried through on a piece of tin or other metal before trying it on the car. Also that the stencil be stored away where it can be found in good condition for use again in renewing the letters on the same car or placing them on a new one.

Initial Transfers. Another way to place monograms and initials on a car is to do it with what are called decalcomania transfer signs such as are used for placing advertising signs on to windows of hardware stores, etc. Transfer signs are manufactured by The Meyercord Co., 133 W. Washington St., Chicago. They can be purchased from those who carry auto supplies and sign painters' materials. These letters come on sheets of paper face down. When soaked with water the letter comes off of the paper.

In order to attach such letters, mark out with chalk a square in the correct location on the surface within which to place them. If there are three letters, for instance, mark out a rectangle with vertical lines divid-

ing it into three equal sections. Place one letter in the center of each section.

The transfer letters come pasted face down on thin paper. Take an artist's water color brush and carefully coat over the **back of the letter only**, not the paper side, with japan gold size, rubbing varnish or special transfer varnish. See that none of the varnish is put on to the paper or it will also adhere to the surface. Let the varnish come fully to the edge of the letter, however.

If japan gold size is used to fasten the letters, it should be permitted to stand about ten minutes to set and get sticky before putting the transfer letter in place on the panel. When varnish is used, more time is needed for setting.

Put the letter on as soon as the varnish is sticky enough to be sure it will stay put; then smooth it out carefully with a wad of cotton and the fingers, making sure there are no wrinkles, that the letter is straight up and down and in the right place.

After putting all the letters on, let them stand two hours or longer if need be, to make certain the varnish has set. Then begin to soak the paper upon which the transfer letter comes with water, using a soft sponge and plenty of water. Give the water plenty of time to soak through the paper and loosen up the paste which holds the letter to the paper. After the paper is wet enough begin at one corner to pull it off. Use great care and go easy. When the paper has come off as far as the edge of the letter, look under it. If the paper is separating from the letter continue pulling easily, but if the letter shows a tendency to leave the surface with the paper, smooth it down again and wait a few minutes. Then wet the paper again and try to remove it. It is a good idea to buy more letters than are needed so you will not run short if you should spoil a letter or two in transferring.

After a transferred letter has been on about twelve hours a thin coat of rubbing varnish on top will protect it. Of course, if placed under the last coat of varnish

on a new or repainted car it has sufficient protection without the rubbing varnish.

Monograms. In place of one, two or three initial letters a well designed monogram adds even a greater touch of quality to the appearance of a car. If you are not handy enough to figure out and sketch a monogram using the initials wanted there are many girls who have made a study of arts and crafts lettering in school, who can readily do it for you.

No rule can be given for designing of monograms except that the surname ought always to be brought out most prominently, either by making it larger than the other letters or by filling it in with a stronger, darker color. Many monograms are made by reversing one or more of the letters and in other ways which cause them to be exceedingly difficult or impossible to read. A better way is to keep the letters faced in the right direction and in such order as can be read, perhaps not at a glance, but after a second look at least. When finished the design should have a pleasing general appearance, it ought to have quite some merit as a decorative ornament. What has been said about colors and materials for transferring initial letters applies fully to monograms. Monograms are to be drawn on or traced on the stencil paper described. The stencil is to be cut and handled in all respects as for single letters. In size and location they are subject also to the remarks about letters.

In Figure 14, will be found some initial letter styles and monograms of good design. They should give you an idea or two that will enable you to make others.

CHAPTER X.

A Touch-Up and Varnish Job.

The jobs which come under this classification are such as are in good shape generally with firm, unbroken color and surfacing coats. The varnish has become dull and needs renewing so the color coats will be protected.

See Section 5, about The Mixing of Colors.

The first thing to do with the car is to remove all loose cushions, rugs and mats inside. While washing the outside and under parts wash out the inside just as thoroughly. Then place the car where it is to be varnished and remove the wheels, tire irons, lamps and any other equipment which can readily be taken off if it is in the way. The car ought to be placed on strong horses or jacks, of course, before removing the wheels.

The top, if mohair or other cloth fabric, ought to be thoroughly brushed and wiped off with a damp cloth. If leather or imitation leather, a wash with warm water and a little castile soap is in order, and a light application of a top dressing made for that purpose improves the appearance.

Lamps, tire irons and such other attachments as have been painted are usually renewed sufficiently with a coat of japan color thinned with a little turpentine and enough of the varnish to give a good lustre.

Touching up bare spots is a particular job. Not so much so when the whole surface is to be given lead, roughstuff or color coats and rubbed, as when none but varnish-color and clear varnish coats are to be placed over the touched up places.

The mixing of new color for the bare spots to match the old color on the surface which has faded more or less requires careful and painstaking effort.

See Operations 31 and 5.

The new color must have just as much gloss as, but no more than, the old because any color gives quite a different effect when thinned entirely with turpentine, to dry flat without gloss, than when thinned with mostly varnish for a high gloss. Use just enough turpentine and enough rubbing varnish together as the thinner for the color to give the same degree of gloss or lustre as the old varnish has before being rubbed with pumice and water. If the old varnish has no gloss at all, spread a brushful of new varnish on the surface to bring out the color. Mix your touch up color to match the newly varnished spot in color and gloss, then wipe off the varnish with turpentine on a cloth before it becomes dry.

Mix your touch up color on a piece of glass five or six inches square and spread it thin on the bare spots with an ox hair, or badger one inch brush for the larger places and a small camel hair artists' water color brush for the scratches and small places.

Lay the color on as thin as possible, and yet have it cover pretty well, because thick color leaves rough edges. Brush it out smoothly, especially the edges, so they will not show where they join the old surface.

Place the color only on the bare spots and scratches. Don't let it run over on to the old paint and by so doing, enlarge the touched up places.

Do not attempt to touch up every little scratch or defect. The new varnish color will cover up such small places. Touch up only such places as will show quite prominently if left without color.

Scratches and small defects require no lead coats to build them up, as are needed by larger bare spots. They simply require cleaning and one coat of japan color thinned with turpentine and enough varnish to give the same lustre as the old surface.

When mixing color to touch up bare spots and damaged places, try it out for a match right on the surface to be matched. You will probably have to experiment a little with the color and change it two

or three times before a perfect match is mixed. Spread a very little of the paint on to the old surface. Look at it carefully to see if too light or too dark, if it needs a little red, yellow or blue. Then wipe the fresh daub of color off the surface with a cloth dampened with turpentine. See Operation 31.

SCHEDULE OF OPERATIONS

The Body

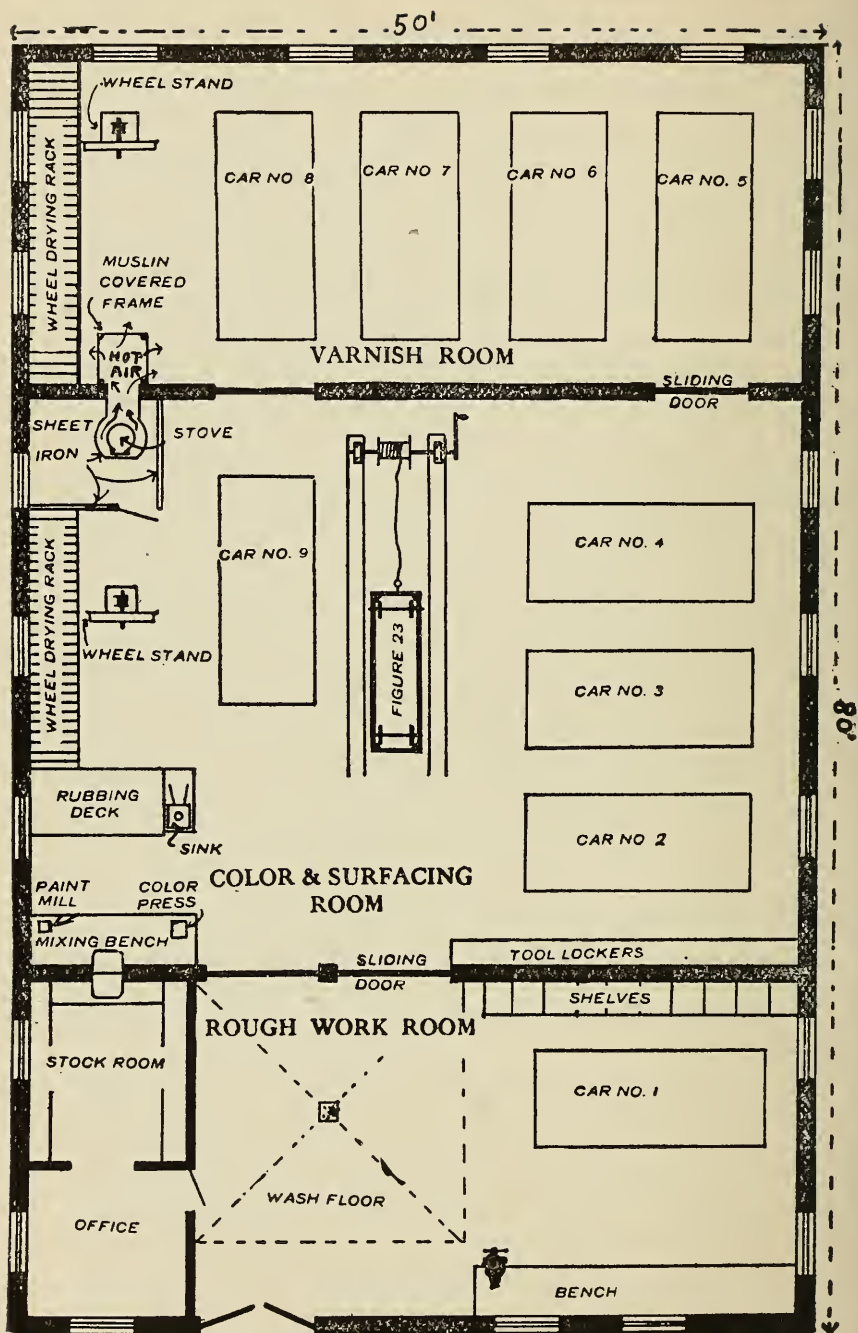
	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	9	
Fill Holes, Dents and Cracks.....	4 and 29	
Touch Up Bare Spots.....	31	
Wash	6	} 2nd Day
1 Heavy Coat Body Varnish.....	17	
Wash	6	} 5th Day
Polish, ready for service.....	18	

A little more elaborate job, and one which would prove more serviceable, would be accomplished this way:

	Operation	
Wash Off Mud and Grease.....	27	} 1st Day
Rub with Powdered Pumice.....	9	
Fill Holes, Dents and Cracks.....	4 and 29	
Touch Up Bare Spots.....	31	
Wash	6	} 2nd Day
1 Coat Japan Color, with Turpentine.....	13	
Rub with Horse Hair.....	11	} 3rd Day
Dust Off	6	
1 Coat Rubbing Varnish, with Color.....	15	
Rub with Powdered Pumice.....	9	} 5th Day
Wash	6	
Initials or Monograms.....	Chapter IX	
1 Heavy Coat Body Varnish.....	17	6th Day
Wash	6	} 9th Day
Polish, ready for service.....	18	

Still another method is to follow the last schedule but omitting the japan color coat, Operation 13, the Horse Hair Rub, Operation 11, and Dusting Off, Operation 6.

The Hood and Fenders, Frame, Springs, and Axles and the Wheels would be given about the same number of operations as the body in each of the above schedules, substituting chassis finishing varnish for body varnish where needed.



AUTOMOBILE PAINT SHOP

SCALE $\frac{1}{8}$ IN. EQUALS 1 FT

FIGURE 15

CHAPTER XI.

The Automobile Paint Shop.

For the successful painting of automobiles, carriages and wagons the three most important and necessary requirements are: The proper kind of materials and tools; the correct method and procedure; a fit and proper shop in which to do the work. The first two essentials have been covered in previous chapters. What is to follow concerning the paint shop is written chiefly for the consideration of the painter who will paint many cars and who, obviously, must get them through the shop in as short a time as possible and in rapid succession to make the business pay. The man who has but one car to paint will find in the discussion, the essential requirements of any room in which a car is painted so he may provide them as nearly as possible, even though they are of a temporary nature.

Probably no class of decorating calls for the use of so many, so fine and so costly material and tools as vehicle painting. They are easily damaged beyond their usefulness by oversight, neglect and carelessness. The fine surface itself, even, will not remain fine very long if not handled properly. With these facts in mind no further argument is necessary to show the importance of being orderly, systematic and careful about handling the car, the tools, the materials and in keeping the shop ship-shape and trim. By investigation, study and experiment find out the one best way to handle the cleaning, painting and varnishing in your shop. Provide the needed conveniences, make the proper arrangements of equipment and then you yourself reduce your habits to follow this worked-out system, this method of working and see to it that your men do likewise. The products of large factories would never be as fine, the quantity

could never be as large nor the cost of production so low if this principle of finding "the one best way to work" was not strictly adhered to. This applies not only to the finishing of automobiles, but to most all profit paying factories, whether the product is shoes, canned corn, nails or machinery. If you work alone in your shop this matter of system and organization is necessary, and if one or more men work with you it is twice or three times as necessary. Good tools and equipment, and an orderly arrangement of them to save time, reduce your painting cost materially because they reduce labor bills. A shop must be operated in an orderly, systematic manner before the efficiency and low cost of production are realized.

Few auto painting shops have been built for that purpose. They are not arranged as they should be for the most efficient handling of cars. How to make the best of what you have, or can get, is the most common problem and each painter must solve that for himself.

The shop arrangements shown in Figure 15, with the detailed description of them to follow, give the essential, necessary and desirable features of well arranged paint shops. A careful study of this will give you the foundation and ideas upon which to construct your shop.

These plans are not presented as having been worked out in fine detail, but merely as general suggestions of arrangements which will promote efficiency.

The heating of the shop is a detail deserving much careful attention. If a hot water steam system can be had the problem is solved as soon as presented. The only special detail is to arrange to have several radiators or a few large ones in the varnish room so that a steady temperature can be maintained at all times regardless of weather conditions. The time required to finish a car can be cut down a day or two when the varnish room temperature can be maintained at 85° to 95° F. Varnishes cannot be properly worked in temperatures below 70°, so that should be the lowest

temperature for brushing and drying as well.

Heating the shop by means of a hot air furnace can be made satisfactory by controlling the dust collected and discharged by the hot air openings into the rooms. To place cheese cloth over these openings would, no doubt, interfere with getting enough heat out of the pipes, but if a box frame about three feet square were covered with cheese cloth stretched tight and placed over the hot air opening it would collect the dust and the hot air could come out of the pipe, expand and sift through the cloth into the room. This cloth covered box would also prevent dust settling into the furnace hot air pipes from the room, only to be thrown out again. The box would have to be taken out of the shop occasionally and the dust accumulation removed from the inside of the cloth.

To heat the shop with stoves is the most difficult and least desirable, and yet with special attention to avoid making dust it can be accomplished. Coal going in and ashes taken out must be wet down and every other precaution taken to raise no dust. Hard coal burning stoves are most desirable, because the most even temperature can be maintained with them with the least dust. Large stoves are best and a removable sheet iron housing, a small room, should be made dust tight, to completely cover the stove on all sides except one which opens into the varnish room. This one opening should lead through an iron pipe about two feet in diameter into a box frame inside the varnish room covered with cheese cloth tacked and stretched tight so that the hot air from the stove, but not the dust, may pass through. This dust catcher ought also to be detachable so it may be cleaned often. If the cloth becomes clogged with dust from the stove it will interfere with the proper heating of the varnish room. Openings in the iron stove housing must be left so a sufficient air current will reach the fire pot. Also a hinged door opening must be made to permit of feeding the stove, to get at dampers, etc. See Figure 17. A regular house hot air furnace would be first class

used in this way after closing up all the outlet pipes except two or three leading to the varnish room. The heat which is thrown off from the sheet iron housing will probably be sufficient to keep the balance of the shop warm enough. If too warm, a coating of asbestos paper will cause more heat to go into the varnish room and less into the balance of the shop.

The matter of keeping the varnish room free from dust, and also the balance of the shop, will require frequent scrubbing. Use a mop to clean floors, never a broom. Window sills, tops of casings and all ledges, projections and such must be wiped often with a wet cloth. The modern vacuum cleaners are excellent for keeping a shop dustless. The shop ought to be plastered or at least wall boards should be laid on to the studding and rafters. It is about impossible to keep down the dust when wall studs and rafters are uncovered and it is hardly possible to properly heat such places in winter.

Keep the shop absolutely clean, allow no accumulations of rubbish or junk, nor anything else not needed to carry on the work of the shop. Then if your brushes, pails and sponges are clean, if the cars are made clean and the material coats are not allowed to go on until the surface or previous coats are really dry your varnish coats will not show grit, flat spots, sweat, bloom, tackiness and such imperfections as result from carelessness.

Buying Paints and Varnishes in Small Shops. There is no reason to assume that the proprietor of the small paint shop cannot buy his paints, colors, and varnishes just as economically and with the same regard for efficiency as the proprietor of the larger establishment.

The proprietor of the small shop should arrange to be forehanded enough to buy direct from the manufacturer all paint and varnish supplies, oils, turpentine, driers, brushes and so on. By meeting his obligations promptly he will very soon establish a

credit that will enable him to obtain reliable materials, and will have a business standing in the trade worth while.

For the small shop with its correspondingly smaller consumption the paints, colors, varnishes, etc., should be ordered to come in small containers. Especially is this to be desired in respect to varnishes. One quart cans are about the correct size for the small shop, as contents will be maintained in a fresher and more workable state. Oils and turpentine are likewise better stored in, say half-gallon cans. Rough-stuff, if bought ready prepared for use, should be handled in one-gallon cans.

All such supplies procured in forms of this size should be stored in clean shelf spaces and made to look presentable. Neat, clean storage of materials in small shops, when a regular stock room is not maintained, makes a favorable impression upon customers. The paint bench, paint mill, mixing slab, etc., should be kept scrupulously neat and clean. A clean shop, however humble, is above reproach. A dirty one is a disgrace even unto the fourth generation.

Scientists claim that without dust the air would be so utterly devoid of moisture that the human family would shrivel up and blow away in short order. It is self-evident, however, that these scientists did not have the interior of the carriage or automobile paint shop in mind when they set forth this dictum. It is stated that a room practically without dust is likewise practically without moisture.

Today the painter as never before is prepared to eliminate dust from the shop. It need not be feared, however, that the dust will be so completely removed as to leave the place without the necessary amount of moisture to facilitate drying of paints and varnishes, and to make tolerable the existence of the painter.

A shop entirely free from moisture would not prove an ideal place in which to dry paint or varnish, nor would the painter find it possible to work in an apartment in which some small degree of moisture does not,

in fact, prevail, and, according to the scientists, where there is some moisture there is also some dust, but, as above stated, the painter is well equipped to combat the dust menace.

The paint shop of former days, despite the most strenuous work of the painter, was a choice storage plant for dust and dirt. Daily cleaning processes were necessary, and even then it was only possible to hold the accumulating dust in check. There is now no reasonable excuse to permit the dust nuisance to get the start of the working force, nor should it be allowed to do so.

All worn pieces of sandpaper, oily cloths or waste and other combustible matter should be collected in metal containers as the work goes along during the day, and all this matter should at nightfall be taken from the shop, then in the morning the vacuum cleaner should be put to work, and the shop given a thorough cleaning throughout.

Left over paint, color and roughstuff should be placed in clean pots and covered over with linseed oil to prevent skinning and an accumulation of dust. If allowed to stand many weeks the oil will get fatty and may make the paint unfit for use. Placed in press top cans or mason jars which are air tight the materials keep indefinitely. Left over varnish should be strained through two thicknesses of cheese cloth back into the can.

The correct ventilation of the shop, particularly the varnish room, is of no less importance than the heating. All coats of materials dry faster and with more uniform color with plenty of light at hand. They are brushed on more evenly than in darker shops. Rapid drying of paint and varnish require a free circulation of air and a high temperature is of little use without air circulation. Just how to gain the air circulation without bringing in a lot of dust with it is the problem. The upper sash openings of windows offer the most convenient means of admitting an air current, but, of course, the openings must be covered with cheese cloth

to keep out the dust. In case of strong winds and dust storms the openings must be closed and on cold days the size of the openings must be reduced. The need for regulating the openings is obvious. Varnish and color coats should never be subjected to drafts and strong air currents, if trouble is to be avoided. Probably the most convenient way to handle the ventilation is to remove the glass from the upper sash of two or more windows, cover the sash with cheese cloth and then fit two hinged doors to the inside of the same sash with buttons or hooks attached so either door or both can be closed or left open as need be to get enough but not too much air. It will be necessary to brush off the cloth over the sash every few days or they will become so clogged as to permit of no air circulation. When the windows are small and too few, it would be better to secure ventilation through other openings to avoid shutting off light.

Providing a large amount of light, both sunlight and electric, contributes a great deal toward efficiency, the turning out of fast and fine work. An abundance of light on all sides of the car being washed, painted, rubbed or varnished is a requirement of first importance. A surface which may appear to be clean, perfectly covered or evenly rubbed while in the shop will often show disappointing defects when viewed out in the open broad day light where all finishing is judged. A touch up and varnish job especially needs good light on all sides to avoid cutting into the old surface too far when rubbing, to make sure all bare and thin places are touched up and to know when the new color matches the old. Artificial lights are never as good as day light but electric lights on extension cords are a great convenience. The matching and mixing of colors by artificial light are not to be thought of as practical.

A shop with an abundance of floor space is indeed desirable as it facilitates the handling of cars, but except when one can build a shop to suit the needs of the business, it is usually too small to be ideal. This fact

emphasizes the importance of having a well organized, systematic and orderly method of handling the work through the shop.

When carriages and wagons were the vehicles being painted, not so much floor space was needed, because they were taken apart quickly and put together again without much loss of time. The construction of the automobile makes it inadvisable usually to do more than take off the top, the lamps, tire irons, the wheels and such parts as can be removed very quickly. It is not often desirable to remove the body from the chassis because of the great weight, amount of electric wiring, the pipe lines and such features as really require the services of a mechanic and the loss of much time. New bodies are most easily finished separate from the chassis and wheels.

When the shop is to occupy a two story building, an elevator, an incline like a toboggan or a lifting arrangement using a block and tackle and a windlass is necessary. To locate the varnish room on the second floor is a preferred plan when the cars can be raised to that level. Then all of the cleaning, the refinishing of wheels and other small parts as well as the general work can be carried on downstairs without fear of raising dust to interfere with the varnishing.

The water supply should be located convenient to the Washing Floor, The Color, Surfacing and Rubbing Rooms. A sink for waste water and washing is quite necessary. Soft water is much to be preferred, as varnished surfaces clean most readily with it.

Window screens are very necessary. Flies will get into paint and varnish and spoil a job quickly.

It is well to have all walls and ceilings painted white so any dust accumulations will readily be seen.

The shop floor must be well supported to carry the weight of several machines. Concrete makes the best floor generally, although a little harder to stand on all day than wood. Whether cement or wood, the floor ought to be oiled to help keep down the dust.

With wages as high as they are today, there is

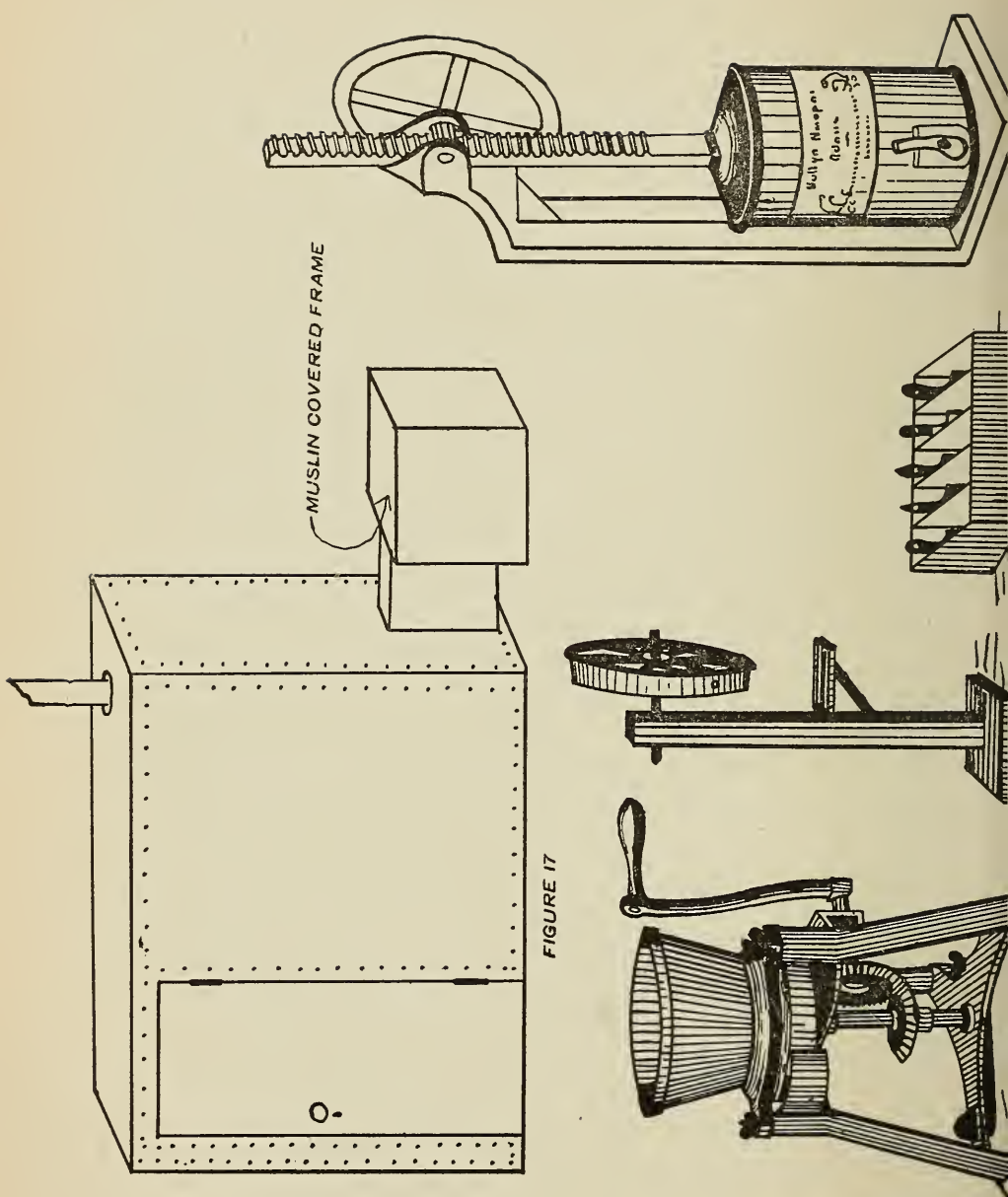
urgent need in every shop of just as much labor saving equipment and every device which will help to keep the number of names on the pay roll down to the minimum. Such modern devices also justify their use by the improved class of work they help to turn out.

The paint mill, hand or power, No. 2, is a great time saving tool for thoroughly mixing roughstuff, putty, fillers and, in fact, all materials. It will hold one gallon and can be purchased for about eight or ten dollars—for the hand power type. Place it on the mixing bench. Figure 18 shows this machine.

The color press shown in Figure 19, is a time and material saver requiring but a small investment, about \$2.00. Ordinarily one pound cans and half pound tubes of colors are most advisable sizes to carry of odd colors not constantly used, but such colors as blues, greens, yellow, umbers, siennas, blacks, etc., are best bought in five pound press top cans. With the color press placed on the mixing bench and the color there too, it is handy to place the can containing the color wanted in the press, open the slide which covers the hole in the side of the can down near the bottom and give the wheel at the top of the press a little turn. When the wheel is turned the verticle bar presses down the loose, sliding top of the can and that forces out the color through the hole in the bottom.

Rubbing Boxes made to contain rubbing materials are a great convenience. One or more such boxes should be on hand for use in the Washing and Rough Work Room, in the Color, Surfacing and Rubbing Rooms and in the Varnish Room. A box about six inches wide, twelve inches long and three inches deep divided into three compartments is about the right size to carry about. A leather strap tacked on to the box like a basket handle is desirable. One section of the box is to be used for felt rubbing pads, one for powdered pumice and one for pieces of artificial rubbing brick.

A rubbing deck or bench covered with sheet, tin or zinc, and sloping one way, so the surplus water will



drain into a trough, is a convenience when the class of work going through the shop requires the finishing and rubbing of many small parts which can be placed on such a bench while being rubbed. The bench should be near the sink in the rubbing room.

Even when only a few cars are going through the shop there will be many wheels to be rubbed, sanded and painted. A wheel standard on the rubbing deck, one in the color room and one in the varnish room for use in laying on the various paint and color coats will increase a man's efficiency by saving his back. Figure 20, shows one way to construct such a standard.

Whenever all of the washing, painting and varnishing operations must be carried on in one large room, the problem of keeping dust out of the varnish can be solved by constructing in portable sections muslin covered frames to form sides and top of a room just large enough to completely surround and cover the car. See Figure 21.

Make wood frames, like those put together for fly screens, using 2x2 inch wood or 1x3 inch stuff. The sides ought to be made in two sections each about 7x7 feet. The ends, make in two sections about 5x7 feet each. In one end or side hang a regular screen door on hinges and cover it with unbleached muslin. Place one or two cross members of wood in each of these side and end sections to make them hold their shape. Then stretch and tack unbleached muslin on each frame.

Coat the muslin with orange shellac made thin with alcohol or spread a couple of coats of linseed oil on the muslin, one inside and one outside. The end and side sections may then be put together around a car about to be varnished. Lap the sections at the corners and screw together, or use screen door hooks and eyes. Where the sections join in the center of the side and end, screw a four or six inch flat board on over the crack so as to fasten both sides together.

A top made of two sections same as the sides will be needed if there is quite a little dust about the place. The varnish will set better without the top but if there

seems to be the slightest reason to expect dust use the top. One corner may be propped up with a pole to leave an opening for ventilation. This cloth room can readily be taken apart and moved from one car to another as needed for varnish coats and is especially useful when cars are being painted in a large garage or such building.

Whenever many small parts such as lamps, tire irons, license numbers and holders and the like are removed from a car it is well to have a box or clothes basket painted and numbered into which every small part of that car is placed as it is removed. With a shelf to place all of the boxes or baskets from the various cars in the shop upon, and someone responsible for keeping them there, no parts should be lost nor one man's equipment placed on another man's car.

A long brush keeper with compartments for several of each kind of brush used would be well worth the small amount the tinner would charge to make it up for you as per Figure 22. A separate keeper should be provided for the varnish room.

Lockers for storing pails, pots, sponges, wash leathers and all such tools are money saving conveniences and also very necessary in maintaining order and systematic operation. A place should be provided for everything and then see that every tool is put back where it belongs each night. Ten minutes spent at the end of each day in cleaning up helps greatly in the progress and quality of the work. Of course, no dusting or cleaning can be done at that hour because there will always be one or more cars which have been coated in the last part of the day which would be injured by the dust stirred up. There is no reason why tools cannot be picked up and a general tidy-up effected. It has a good influence on the quality of the work.

The floor pit, commonly used for mechanical repairs in garages, is thought by many to be very desirable for getting under the car to clean and paint the chassis. There is an element of danger connected

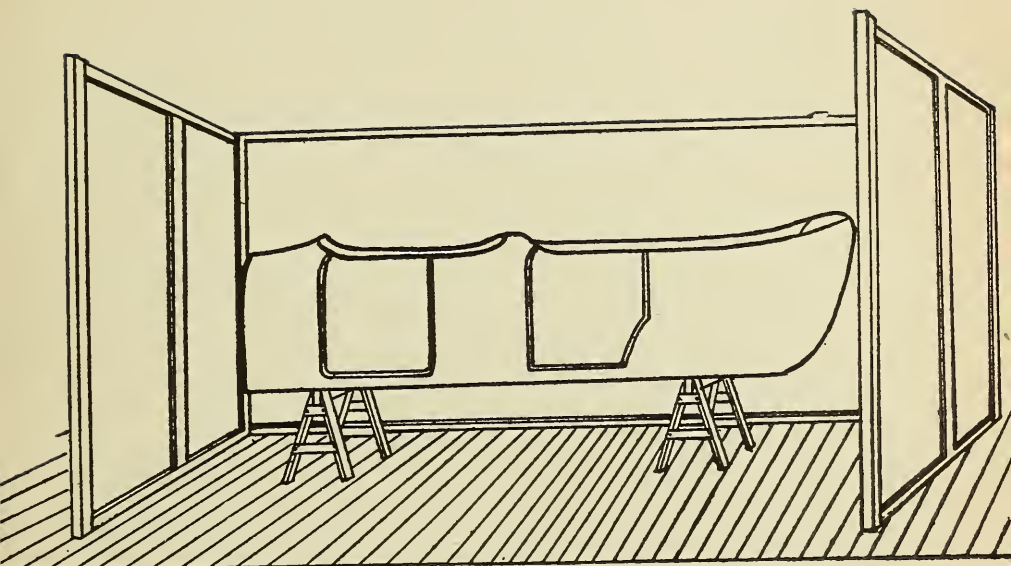


FIGURE 21

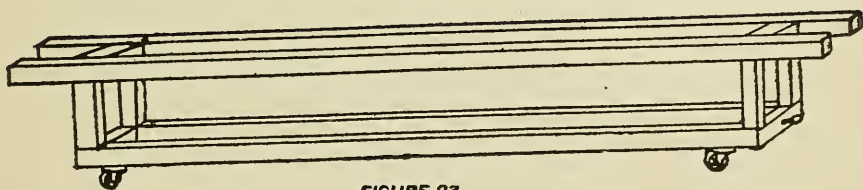


FIGURE 23

with its use, however; cars have been driven into them and other accidents occur. The pits are usually very dirty and difficult to keep clean. It is not always possible to have a pit in rented quarters.

The bridge and truck arrangement illustrated by Figure 23, is one that can be used anywhere and easily constructed. The car is run upon this bridge, while its wheels are on, and with its own power or by use of the windlass crank and drum shown. The wood truck with large casters on it is run under the car. Then both the car and truck are pulled back so the car starts to back down the incline leading up to the bridge. When the car comes down the rear axle rests on the truck frame lifting the wheels clear of the incline track as you continue to pull both back. When the front of the car comes down far enough the front axle also rests on the truck frame and all four wheels are off the floor. The wheels may then be taken off and the car on the truck moved to the place in the shop allotted to it for cleaning, painting and varnishing. A thorough wash off of all mud should occur before the car is mounted on the truck.

The truck raises the car high enough off the floor to permit a man to work on the under parts in a sitting posture. That is important, considering volume and quality of work accomplished. There is no more disagreeable work anywhere than lying on one's back or side under a car soaking up grease which runs out of the best of them and trying to do a creditable job. Half a day under a car is a full day's work.

The roller casters to be used in making these trucks can be purchased readily through any heavy hardware firm. The frame of the truck had best be constructed of 3x3 inch oak, maple, birch or some such strong lumber bolted together. Any blacksmith can make the windlass.

The practice of sprinkling the varnish room floor is likely to give trouble in the form of varnish bloom, pin holes and flat spots. The moisture is taken up by

the air while warm and should the temperature drop a little at night, condensation occurs and the moisture settles on the varnish. The floor should be oiled and then the cleaning should be done with a mop early in the day.

Unnecessary walking about the varnish room, the closing or opening of doors quickly and any movements which stir up dust should be avoided.

As to the tool equipment for a small shop "The Vehicle Monthly" has presented the requirements below so well that the author can do no better than to reprint the specifications:

The tool equipment for a small carriage or automobile paint shop may consist of the following: Three good square pointed half elastic putty knives, one beveled point putty knife, one round point, a couple of good palette knives, and one 2½ inch half elastic scraping knife. Also half a dozen soft fleece wool sponges, prime quality, at least three good chamois skins or wash leathers, one-half dozen galvanized iron pails, three-gallon capacity.

In brushes half a dozen oval chisel-pointed paint brushes, of medium size; half a dozen camel hair, 1¼ and 1½ inches wide; at least three 2½ inch camel hair brushes, three badger hair varnish brushes, 1½ inches in width; three oval chisel-pointed varnish brushes; two sets of flat, half elastic extra quality bristle brushes, each set consisting of four brushes running in size from one to three inches, one of these sets to be used exclusively for applying the finishing coat of varnish to carriage and automobile bodies. The second set to be used for applying rubbing varnish to such bodies. A couple of sash tools, chisel-pointed brushes will be needed for washing up work preparatory to varnishing.

Of dusters there should be three good flat bristle dusters for body work, the same number of oval bristle dusters for both body and gear work, a couple of spoke brushes, together with a complete set of striping and

lettering pencils, the striping pencils to consist of sword and dagger pencils made of camel hair in sizes to draw the various lines, running from a fine line to a full stripe.

The lettering pencils to be of black sable, 1½-inch length, of hair set in metal and running in size from No. 1 to No. 8.

About three flat bristle chisel-pointed varnish brushes will be needed for varnishing heavier wagon parts and miscellaneous work.

The bristle paint brushes should be kept in water when not in use, being suspended by the handle from a wire in the water up to the ferrule of the brush. Camel hair brushes to be kept in either water or raw linseed oil, this depending upon whether the hair of the brush is set in glue or not. Varnish brushes to be kept, when not in use, in the brand of varnish which they are employed to apply.

These brush containers should be air tight and dust-proof, and under lock and key.

All dusters should be kept in a compartment, usually a drawer under the paint bench. Here, too, should be kept the sponges and chamois skins; putty and palette knives should also be kept in such a compartment. Incidentally it may be best to keep these compartments also under lock and key.

The small shop will also need a couple of good revolving wheel jacks, two revolving gear trestles, one revolving body trestle, two pairs of strong wooden horses, for automobile work; a stout wagon jack, one pair of bolt clippers, one pair of shaft fasteners, half a dozen "S" wrenches, of various sizes, running from ½ inch to one inch; one large and one small monkey wrench, two strong screw drivers, hammer, saw, brace and bits, cold chisels, one large, one small; two punches, and such other small utensils as the condition of the service will warrant.

Also there should be a No. 2 paint grinding mill; one moderate size vacuum cleaner of an approved type, three galvanized iron containers for holding waste,

sandpaper, oily and greasy rags, and other forms of shop refuse and dirt. One paint burning lamp of one gallon capacity, and half a dozen blocks of artificial pumice stone, medium fine.

CHAPTER XII.

Carriage and Wagon Painting.

The painting and refinishing of these vehicles does not differ essentially from automobile painting except slight changes to allow for a wood surface rather than metal. After touching upon the points where the treatment of wood surfaces differs from that for metal there is no advantage in repeating the auto painting process so the schedule to follow will refer by number to the auto painting operations in Chapters V, VII and VIII which are equally suited to carriage and wagon painting.

Generally speaking, carriage and wagon painting today is not required to be up to the standard wanted twenty or thirty years ago. Prices paid for this class of work are lower than at that time and customers are satisfied with fewer coats and a cheaper job. A very fine class of work is still turned out on bakery, milk and other business wagons as well as upon hearses and undertakers' rigs but these are exceptional and the number of such jobs is a small part of the whole.

The materials to be used for carriages and wagons may be identically the same as for automobiles or in place of auto varnishes the special carriage varnishes may be used. Other materials and the tools required are the same.

FINISHING A NEW VEHICLE.

A First Class Job.

Section 25.

Sandpaper all parts with No. 1 paper, being particular to smooth down all raised grain or other rough places. A little time spent in making such places

smooth before painting will save much effort and exasperation later over little points of wood fibre which may come through the paint body when rubbing to level and smooth up the paint coats.

Cut down all very sharp edges of mouldings and corners, using No. 0 sandpaper. You cannot keep paint on them because rubbing quickly cuts through such sharp corners.

Clean all metal of rust and grease.

Shellac screw heads and any knots or sappy places. Cut the shellac quite thin with alcohol.

Remove all dust, grease and dirt by wiping with a cloth dampened with turpentine and a duster brush. Corners of mouldings and such crevices about irons as hold dust must especially be cleaned out thoroughly.

Priming Coat. Make a very thin mixture of pure white lead-in-oil, using about one-half pure raw linseed oil and one-half turpentine. Add about a teaspoonful of coach japan to a quart of the mixture. Only enough lead is wanted to stain the mixture, it is not expected to cover well. It should penetrate deeply into the grain to establish a good foundation.

Brush this coat on evenly using an oval varnish brush, or three inch flat color brush. Lay the coat off smoothly, brushing with the tip of the bristles the same way as the grain runs. Brush this coat well into all cracks and holes.

Let dry at least 24 hours, a longer time would be better.

Second Coat. Mix same as priming coat, but add a little more lead and enough lamp black or coach black to make a light gray shade. Try to fill all real small holes with paint, instead of putty later. The air at the bottom of them makes it difficult to force putty deep enough to stay, the air forms a cushion. Vibration later forces the putty out. Fairly large holes do not offer this difficulty. Let dry 24 hours or more.

Putty. Mix and apply as per Operation 4.

Sand paper. A light rub, just hard enough to cut

off dirt nibs and wood fibres which may remain. Use No. 0 paper.

Dust Off. As per Operation 6.

Roughstuff Filler. Apply from one to six coats according to how fine a job is to be turned out. Mix as per Operation 7. If the surface seems pretty dry and porous after the first coat, add a few drops only of linseed oil to the mixture. Sandpaper each coat very lightly with No. 0 paper and dust off before brushing on the next coat. Let each coat dry 12 hours.

Stain Guide Coat. Mix as per Operation 8.

Rub. With Artificial Rubbing Brick as per Operation 9, wash up as per Operation 6.

Lead Ground Coat. Tint to suit as per Operation 10. Allow 12 hours to dry. Then rub with horse hair as per Operation 11. Dust off.

Color Coat. Mix and apply as per Operation 13. Let dry 12 hours and rub lightly with horse hair and dust off. Then apply a second coat in the same manner. For a black finish mix the first coat from lamp black and turpentine, the second with coach black or ivory black and turpentine.

Varnish Color. Mix as per Operation 15. For black jobs use in place of this rubbing varnish and color one or more coats of black japan. Allow 48 hours or longer for drying.

Rub. With powdered pumice and water as per Operation 9. Wash up,—Operation 6.

Finishing Varnish. Apply as per Operation 17. Carriage varnish may be substituted for automobile varnish, but the latter is suitable. In the case of wheels and gears use chassis finishing varnish or carriage gear varnish.

Wash up and polish after three or four days and the vehicle is ready for service.

Rub-Lead. As a means of producing a fine surface quickly on new work what is called the rub lead treatment is often used in place of the second lead coat. It is mixed this way:

Dry White Lead, enough for a stiff paste.

3 parts Raw Linseed Oil.

1 part coach japan.

A touch of black or umber.

Grind through a paint mill set fine. Thin to stout brushing consistency with 3 parts raw linseed oil and 1 part coach japan.

Brush on this mixture, let stand a few minutes until it sets a trifle and then rub into the wood with the palm of the hand, better put a leather glove on. After a thorough rub all over let dry two or three days, then sandpaper with No. 00 paper. An exceptionally dense and fine surface results from this process and the roughstuff coats are not wholly necessary. Substitute for them a coat of white lead thinned with turpentine only and brush on smoothly with a color brush. Rub with No. 00 paper, dust off and the surface is ready for the flat color coat, the varnish color and the finishing varnish.

GEAR AND WHEELS.

These parts should be given exactly the same schedule as has just been specified for the body but eliminate the priming coat and begin with the second coat. One coat of roughstuff is usually sufficient.

QUICK JOBS.

Time and expense can be saved by cutting down on the number of coats listed for a first class job. The job can be turned out with but one roughstuff coat and one color, using the same schedule otherwise as listed. Or, if need be, all roughstuff coats can be eliminated. It is not advisable to cut the schedule more than that, however.

REFINISHING JOBS.

Section 26.

These are handled in all respects the same as the schedule just given for new work except that when the old finish is good the refinishing begins with the lead ground coat, the color coat or the varnish color

coat according to the condition of the surface. See Chapter VIII concerning this. What is said there about automobile surfaces is relevant. Also the methods of removing the old paint and varnish coats given there, is useful on wood surfaces as well. No strong alkali or caustic paint removers are permissible for use on wood, because once this material soaks into wood, it plays havoc with the new coats put over it. The patent liquid paint and varnish removers are usually safe if the surface is well washed with turpentine after removing the paint.

WAGON PAINTING.

Section 27.

The finishing of wagons of the better class ought to be carried on after the specifications given for carriages and automobiles. Some wagons get along nicely with a less elaborate treatment.

Practically all wagons painted in the job shop have been painted before, at least once, in the factory where they were built. So the specifications below refer to repainting jobs. New jobs would be handled in the same way after smoothing down with No. 1 sandpaper, the applying of a lead priming coat, puttying and the laying on of one to four coats of rough-stuff as mentioned for carriage and automobile painting. Read over Chapters V, VII and VIII about finishing and refinishing automobiles. The tools, materials and methods are the same.

The first operation in refinishing a wagon is a thorough wash and clean-up as per Operations 1 and 6.

Sandpaper the surface well, using No. 1 paper, then dust off.

Putty all holes and touch up bare spots as per Operations 4 and 31.

Apply one or two coats of white lead tinted something like the finished color wanted, as per Operation 10.

If the surface is still quite rough and not level give

it the knifing lead and putty glaze treatment as per Operation 12.

Sandpaper carefully with No. 0 paper and dust off.

Apply one coat japan color and turpentine, Operation 13.

Rub lightly with horse hair, Operation 11.

Brush on one coat of rubbing varnish with color, Operation 15.

Rub with powdered pumice and water, Operation 9.

Wash up, Operation 6.

Finish with one coat of heavy hard drying Coach varnish.

TOUCH UP AND VARNISH JOBS.

Section 28.

The handling of this work does not bring a large enough price to justify spending quite a little time in mixing colors to match for the purpose of touching up damaged places and worn off spots. It is much better to coat in these places carefully with lead thinned with half turpentine and half raw linseed oil, adding a few drops of coach japan and a little color, after giving the whole surface a careful rub with No. 0 sandpaper. Then mix up a coat of japan color to match as nearly as possible the color of the old paint and brush this onto the whole surface. See Operation 13. From this point on, handle the job with a coat of rubbing varnish with color and a coat of finishing varnish.

CHAPTER XIII.

Factory Painting Methods—Spraying, Flowing, Dipping and Baking.

In this chapter an effort will not be made to give every detail of these processes. That would complicate matters and make hard reading, because there are no standard methods of finishing by these means. Every manufacturer has worked out a process which handles his work to satisfy his trade. Even manufacturers turning out the same kind of product handle the finishing differently. In the matter of details this is equally true of automobile manufacturers as of others. Each has designed and built special equipment such as spraying cabinets, overhead trolley and conveyor systems, heating, ventilating and lighting schemes.

The principles involved, however, and equipment used are much the same whether the product to be finished is a piece of harvesting machinery, a sewing machine, a desk or an automobile. The materials used for dipping, spraying and flowing-on automobile parts are better than are needed for harvesting machinery and the like, being as nearly the same as for brushing as the different method of applying will permit. Only the smaller parts such as fenders, axles, lamps and the like are dipped. The body finish is sprayed or flowed on. So a general outline of the processes and equipment used by some manufacturers will convey a fair impression of what has been and is being done along this line of modern finishing. Then each one must work out his own details, equipment and methods.

The advantages offered by these modern methods are apparent and well known. Increased production is the chief motive for developing them, although the

saving in labor and in space are very material. The quality of finish in most instances is superior in appearance to much that is produced by the brush method, but the latter is more serviceable often, with enough time given to the work. These processes, to be sure, are valuable chiefly in plants where quantity of production is a vital factor. Automobile factories turning out from one hundred to a thousand cars per week or month would find the task of finishing so many bodies, wheels, fenders and other small parts required impossible without the aid of these processes. And to provide the space alone needed to finish so many bodies by the slower hand brushing and drying method would bankrupt the corporations.

The possibility of factory methods being of use to some small job shop painters may be remote, except as a knowledge of how the original painting of the cars they work on enables them to judge more accurately what treatment to employ for refinishing. And yet, the painter possessed of a little ingenuity can modify and adapt them to his needs and to his advantage. The larger shops are able to use the factory spraying, dipping, flowing-on and baking processes in a modified form. Aside from the utility feature of factory methods, the automobile painter in job shops is interested in knowing how the factories operate in turning out such a tremendous volume of finished cars in so short a time. And well he might be, for these same enameling, spraying, flowing-on, dipping and baking processes will, before long, be developed for use in all job shops. Even now some of the city shops employ them. Both the methods and equipment are sure to be worked out eventually so every shop will use them when quite a volume of work can be secured.

Without factory methods the painter can do, with equal care and suitable shop facilities, as fine finishing as can be turned out of any factory. The hot-room, if not the oven, helps get the cars through faster and he can make up in the durability and serviceableness of his finishes for what he lacks in speed.

MATERIALS.

Most all large paint manufacturing and varnish making firms produce special paints, enamels, varnishes, primers and fillers for use with the factory processes of spraying, dipping, flowing-on and baking. It is most satisfactory to purchase these materials from a reliable manufacturer who will know just what you need when you have specified how and where the material will be used. Here are some firms who can be depended upon to furnish the correct materials:

The Sherwin-Williams Co., Cleveland, O.

John Lucas & Co., Chicago, Ill.

Chicago White Lead & Oil Co., Chicago, Ill.

Moler & Schumann Co., Chicago, Ill.

John W. Masury & Son, New York, N. Y.

Glidden Varnish Co., Cleveland, O.

The ordinary material made to be brushed on and air dried is not satisfactory for baking. For best results with any of these methods the materials ought to be mixed especially to fit the surface and mode of applying it, in fact, the success gained depends upon using just the right material for the purpose. As a rule these special paints, enamels, primers and fillers are bought in paste form, ground very fine in varnish and are then thinned as needed with a specified quantity of varnish, benzine, naphtha, turpentine, turpentine substitute, white spirit or a mixture of two or more of these volatile liquids. Such materials dry hard in from one to twenty-four hours according to the treatment, temperature, etc. The pigment must remain in suspension a reasonable length of time, and not separate from the liquid too soon. In large tanks it is difficult to stir up the paint every day or oftener if the pigment settles to the bottom. A flow of compressed air, moving paddles and other mechanical devices placed in tanks are used to agitate the paint to avoid this separation of pigment and liquid when necessary.

The comments to follow immediately concerning

materials are intended only to convey an idea of how these special paints are mixed for some manufactured products finished by the factory methods under discussion. To make one's own mixtures, it will easily be seen, requires an intimate and expert knowledge of all such materials in action, alone and in combination with others, a thorough understanding of surfaces and working conditions, and more or less experimenting. Paint manufacturers who supply these special paints are well posted concerning these things. The consistency and action of a mixture must be just right. If too thin, too much will run off the surface and so the article will not be sufficiently covered. A little mixing varnish in the paint helps to hold it in place. If too thick it runs, drips, sags, wrinkles and fat edges occur. These can be controlled to some extent by catching them up with a soft fine brush immediately upon finishing, but if the mix is not proportioned correctly as to liquids and pigments the paint may run again while drying, even after having been smooth and fine. A little experimenting with various consistencies will enable one with patience, the power of observation and analysis to put together just the right mixture for each particular kind of surface. Needless to say every batch mixed for experimental purposes, and for stock use too, for that matter, should be carefully measured,—the whole mixture and each ingredient separately and careful records kept. Then any mixture can be again put together for further experiment, especially those which show some, if not all, desirable qualities. When the correct mixture has been found to give the results wanted the formula will be known and can be reproduced.

To attain the qualities of hard and quick drying in paint, only varnishes made with that end in view and such of the drying oils as are permissible from the standpoint of cost are suitable. The long oil, elastic varnishes are more durable than quick, hard drying varnishes, but their slow drying makes them impractical. Among the most suitable drying oils are lin-

seed oil, china wood oil and soya bean oil. The non-volatile heavy mineral oils, fish oils and some others offered as substitutes for pure linseed oil or used to adulterate that product are not to be considered, low cost being about the only element in their favor.

Both the oil and varnish are depended upon to anchor the paint to the surface and to bind the pigment together. The varnish also is needed to help keep the pigment on the surface and cover it, to avoid runs, sags, drips and fat edges. The oil also, furnishes the elasticity needed by the paint to enable it to accommodate itself to the expansion and contraction of the surface with heat and cold. With too large a quantity of linseed oil in its composition it would not dry hard nor quickly, and the paint would wrinkle, run and sag. Oil helps the pigment to spread out to an even thickness on the surface and to flow together.

Benzine, naphtha, turpentine, turpentine substitute or other white volatile spirits are used merely as a mechanical means of depositing the paint on the surface. They evaporate in a few minutes and have little or no binding effect upon the pigment. Generally the paint should be made as thin as possible with the benzine or other liquid and yet have it cover the surface well and stay where you put it.

The white spirit is a petroleum product costing less than half as much as turpentine. For many paint dipping mixtures it serves as well as turpentine. The white spirit having a flash-point of from 80 degrees to 90 degrees is very extensively used by manufacturing plants.

Enamels used for spraying, dipping and flowing become a little too thick after being exposed in tanks a while. Add a little kerosene (with a specific gravity of 81 degrees at 60 degrees F.) to thin and give it a flow. Nothing but turpentine should be added to white enamels. Kerosene will turn them yellow.

When considering the pigments for spraying and dipping paints the specific gravity, which is the relative density of each, is all important. Those having

the highest specific gravity are often too heavy for use in large dipping tanks without quite elaborate stirring and agitating machinery to keep the pigment from settling to the bottom in too short a time. Practically all of the most useful pigments separate from the liquid and settle to the bottom of the tank after a day or so of idleness. Below is listed the commonly used white and colored pigments, giving the specific gravity of each:

White Lead. Specific Gravity 6.750. The most opaque, best covering and hiding of the white pigments. Not generally useful for large dipping tanks unless with stirring and agitating machinery in the bottom of the tank, because of its weight and density which makes it settle to the bottom of the tank a little sooner than other white pigments. Its greater ability than all other white pigments to cover and hide a surface gives it considerable advantage for white, grays and all light colors, whenever it can be practically handled to avoid the settling of the pigment in the bottom of the tank by the use of agitators or small tanks which can be stirred occasionally. This greater opacity of white lead makes it possible to use a slightly thinner paint than when other white pigments are used as a base for paints.

Other important qualities of white lead as a base for paints are worth mentioning. It possesses an unusual affinity for linseed oil. Thinned with turpentine it makes a paint of superior surfacing qualities capable of being sandpapered, or rubbed with pumice and water, to a dense fine appearing surface. These are the qualities which have enabled it to hold first among carriage and automobile painters everywhere in spite of the many substitutes offered.

Zinc Oxide. Specific Gravity 5.470. This white pigment is used alone, in combination with white lead and with other white pigments for making the grays and other light colored paints. It is less elastic than white lead and when used alone may promote cracking and scaling, but with twenty-five or fifty per cent of

white lead it makes for fine results. Zinc is a finer pigment than lead and is better for spraying for that reason.

Zinc and white lead are the two white pigments to be preferred. In general practice zinc usually predominates in quantity. When other pigments are added it is largely to cut down cost of the paint and to introduce lighter pigments which remain in suspension longer. The paint thus produced is sufficiently durable for the life of the product coated. Enough lead or zinc ought to be used in the paint to give covering, surfacing and flowing qualities. There are numerous practical and technical men of experience who believe that the adulteration of lead or zinc with from ten to twenty-five per cent of inert pigment or pigments, such as asbestine, silica, barytes, whiting or china clay improves the paint materially for factory use.

Asbestine. Specific Gravity 2.344. Because of the low density of this white pigment it is considered the best by some to extend white lead and zinc mixtures and to keep them in suspension in the liquid. It improves dipping paints by keeping the pigment from settling too rapidly, but is a detriment to paints to be spread with a brush. It interferes with their spreading out level and flowing together.

China Clay. Specific Gravity 2.110 to 2.617. Remains in suspension well when mixed with a liquid and has some claim to merit for use as a suspension agent in paint mixtures. It is not very opaque, however, and so its use lessens the ability of the paint to cover and hide the surface.

Whiting, Bolted. Specific Gravity 2.673. Is used to some extent. Having somewhat of an alkaline nature, coming from lime rock as it does, it is detrimental to certain colors.

Silica, Floated. Specific Gravity 2.596. Used in primers to make a surface with a "tooth" to catch hold of the second full bodied dipping coat. Made from ground rock, and so is of a crystalline nature. Gen-

erally used in moderate quantity in dipping and spraying paints with the idea that it helps drain off surplus paint, in the case of dipping, giving movement to the paint to assist in flowing together and leveling up.

Barytes. Specific Gravity 4.144.

Colors. The following colors having a low specific gravity are especially useful alone and for tinting white pigments to be used for dipping. The earth pigments, siennas, umbers, ochres, iron oxide reds, venetian red, etc., are not as strong in tinting ability as chemical colors like Prussian blue, chrome green and chrome yellow. They cannot, therefore, withstand as much adulterating with clay, silica, barytes, whiting and such inert pigments for ground coats of paint which are to be varnished over. When earth colors are to be used with enough varnish to produce a gloss finish they will not stand adulteration at all:

Ochre	Specific Gravity	2.822
Venetian Red	Specific Gravity	3.560
Indian Red	Specific Gravity	4.732
Raw Sienna	Specific Gravity	3.081
Burnt Sienna	Specific Gravity	3.477
Raw Umber	Specific Gravity	3.496
Burnt Umber	Specific Gravity	3.518
Prussian Blue	Specific Gravity	1.956
Ivory Black	Specific Gravity	2.319
Chrome Green, Med.....	Specific Gravity	5.239
Chrome Yellow	Specific Gravity	5.842
Iron Oxide Red.....	Specific Gravity	3.496
Lamp Black	Specific Gravity	1.691

Some manufactured articles in and out of the automobile industry are finished with one dipping, some are dipped two coats and some three. In certain instances a priming coat is brushed on, the second dipped and a third dipped. And again, a brushed on primer, dipped second coat and a sprayed-on or brushed-on finishing coat comprises the method.

When the paint is to finish with a gloss it is necessary simply to increase the amount of varnish and decrease the oil and benzine. If more than one coat is to go on, the coats should be mixed to dry alternately flat (no gloss) and gloss; that is, always place a gloss

coat on top of a flat one and vice versa, if you would have it stay there and anchor well.

A varnish finishing coat is sometimes made to carry a little color. A varnish-color or an enamel is made of it, in other words, according to whether the quantity of varnish is greater than the quantity of pigment or the reverse.

Every precaution known is taken to eliminate dust from rooms where dipping, brushing, spraying, flowing and baking of materials are carried on. Walls and floors are oiled, the air supply is water washed, windows and openings are dust proof and no one is permitted to move unnecessarily about the room. The quick movements of a person walking, and especially the closing of a door quickly, can stir up enough dust to spoil a fine varnish coat.

Considered only from the standpoint of detail each automobile factory is a law unto itself, but in general principles and systems used they are all quite alike. One factory will dip certain parts which others spray, while another plant will flow on the body finishes rather than spray them. Some plants spray on the primer, while others brush it on. Many hold to the rule of always brushing on the finishing coat of varnish over sprayed or flowed on undercoats. This last varnish coat is usually air dried, or baked an hour or two at a low temperature, 90 degrees to 120 degrees, just enough to set the varnish dust free, and then air drying is depended upon to finish.

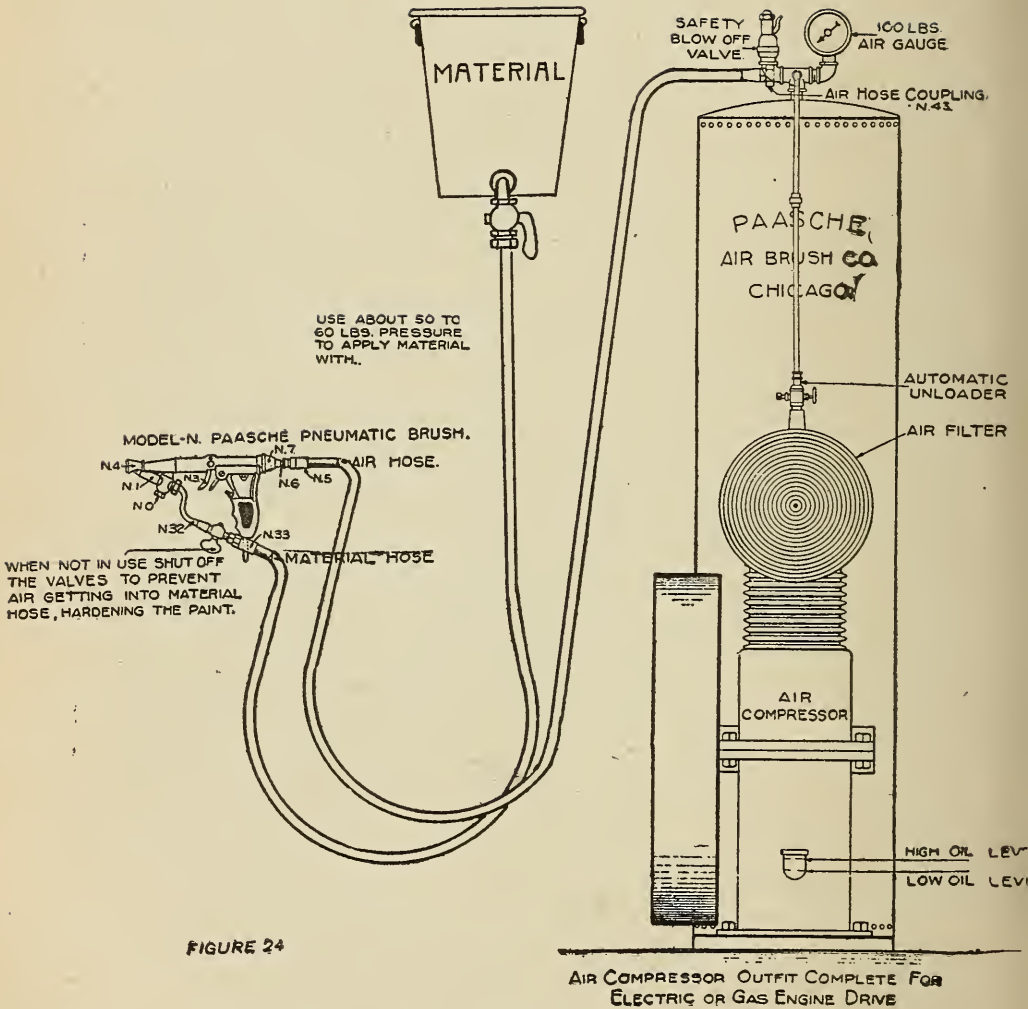
Most plants where automobiles are built and painted were built specifically for that purpose, and so each building, each department, each piece of equipment and machinery were placed according to a previously worked out plan. Each automobile, and each part of it begins at a certain specified part of the factory and is routed to travel through each operation of building in a progressive manner. When each part of the car has been completed in its shop it arrives at a certain point ready to be used with other necessary parts to be assembled into a completed car ready to be painted.

For illustration start with the frame. The pieces of channel steel are cut and riveted together in one shop, the frame is then cleaned and dipped to prime coat it. When dry it is placed upon a low truck large enough to hold the completed chassis. The truck moves out of that shop into another long building. It is stopped just long enough to bolt on the springs which have been previously bolted to the axles. The truck is pushed on to the next crew of workers who bolt on the wheels. The next move is perhaps to have the engine put in place, then the radiator, the hood, body, fenders, running board, windshield, top and other equipment. When the car reaches the other end of the assembly shop it is ready for the purchaser. Once started through the shop, the car goes forward always at a regular time; never back and forth from one operation to another because that loses time, causes confusion and interferes with inspection. Each part,—the axles, wheels, frame, fenders, body, etc., has been finished ready for service in its own shop before being assembled with other parts to make a car. Each part has its own painting schedule, route and time to go through from start to finish. Small parts are dipped. Springs, axles and wheels are usually finished by spraying all coats. Bodies receive various treatment,—usually a sprayed or brushed-on primer; sprayed or flowed-on filler, color and rub coats; and brushed-on or flowed-on finishing varnish. The brushing operations are carried on in the usual manner followed by all auto and carriage painters. Having so much practice in each line of work, the painters doing it become experts of the highest type. The spraying, flowing, dipping and baking operations will be discussed separately in the following paragraphs.

SPRAYING.

Section 29.

The coating of surfaces with paint enamel, rough-stuff, color and varnish in this manner requires the use of what is called the air brush. For many years



there have been various kinds of spraying instruments on the market, but they have been used mostly for water paints, white wash, calcimine and other thin mixtures. It remained for the perfected machine of today to really succeed in spraying the heavier mixtures.

The early types of spraying instruments which were successful only with white wash and the like carried thirty or forty pounds pressure on top of the material in a tank. The material came out of the nozzle in a solid stream instead of a fine spray; it didn't break up. Of course the machine wouldn't spray such a heavy liquid as varnish or oil paint.

The next type preceding the present day brush is still on the market and is used for spraying disinfectants on plants and animals. The liquid is placed in a can below the air nozzle. A pipe from it leads to the air opening from a pump or hose. It depends on the vacuum principle. The air rushing over the open end of the material supply pipe raises the material and throws it on to the surface as a spray. This type was an improvement over others, but still it failed to handle the heavy oil paint and varnish mixtures.

The present day air brush is called a concentric type. The air and the material do not meet at the outlet of the nozzle as in other types but in a tube, sort of a mixing chamber, before coming to the nozzle opening which is cone shaped. That throws the air and liquid together before going out of the nozzle opening, which is smaller than the mixing tube. A needle valve with the shank running through the mixing tube, opens and closes the hole in the nozzle from the inside by pulling a trigger. To some extent this needle valve shank obstructs the passage of air and material through the opening and that helps to break up the liquid into small atoms to form the spray.

The principles upon which this final and present day air brush is built give it many advantages over former designs and especially over hand brushing. It will apply, with special nozzles for each material, prac-

tically all paints, varnishes and enamels whether mixed in oil, water, varnish, benzine, turpentine or alcohol.

It is four times as fast as hand brushing for the application of these materials which means not only increased production for the paint shop but also a saving of labor cost and of time. It is obvious then that the air brush equipment is of value only for shops having a large business, or those at least which can secure a much greater number of jobs than they have been able to handle without this new equipment. The material is distributed to a more uniform depth over the surface than can be attained by brushing.

The most remarkable feature about this method of applying paint, varnish and enamels is the exact control exercised over the quantity of material put on to the surface and the width of the spray. The spray is started, controlled and stopped instantly by pressing and releasing a finger trigger. With certain models of the air brush a fine line spray is steadily increased in width on the surface until it is several feet wide. The control of the spray is perfect. The harder the trigger is pulled, the more air is released and the wider the spray becomes.

By using a special nozzle a thick, heavy enamel or varnish can be sprayed quite as readily as a thin mixture. With a small, finely set nozzle the air brush can be used for small pieces of jewelry and enamel ware. Air brushes have been in use for a long time by artists for wash drawings and various kinds of work about art studios and engraving houses. Such work requires much more accurate control and use of the instrument than any automobile painting. Indeed few people realize how extensively the air brush is used by manufacturers of such products as sewing machines, bicycles, gas meters, street cars, picture frames, gas stoves, electrical parts, automobiles and many other articles.

The amount of air pressure needed to operate an air brush ranges from twenty to eighty pounds per square inch, according to whether thin varnishes or thick

paints are being sprayed on. The most desirable pressure is the lowest that will break up the material into a spray. From one to three cubic feet of air per minute are used.

The amount of material used is greater or less than is used by the ordinary hand brush according to the care taken by the operator.

An inexperienced workman can be taught to operate the air brush in a much shorter time than to do a good job with an ordinary brush.

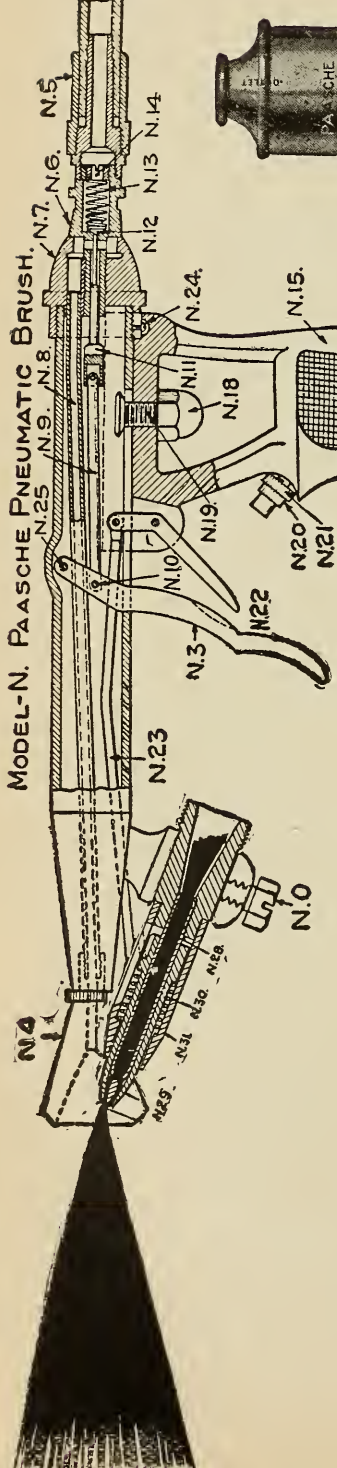
Automobile and carriage finishing varnishes are sprayed on as nearly as possible in the same consistency as they are received in the can. Rubbing varnishes are thinned a trifle with turpentine, they do not flow together on the surface quite as readily as finishing varnish. It is not so important that they be sprayed on in as heavy a coat as in the case of finishing varnish. Lead coats, roughstuff and japan color coats are sprayed on quickly and perfectly, after being thinned a little more with turpentine than would be desirable for application by hand rubbing. They are laid on smoothly and, having no brush marks, require less rubbing.

In general paints and enamels which are of the right composition and consistency for dipping are also about right for spraying, although it is practical to apply much thicker enamels and varnishes by spraying than by dipping. Paints and enamels having a too heavy pigment (too high in specific gravity) may often work no better by spraying than by dipping, because of the settling of the pigment to the bottom. Too heavy pigments may give an uneven appearance to the finish. Heavy pigments which settle too rapidly can be more easily, cheaply and conveniently stirred by the agitators of the air brush equipment than by such means as are usually possible and at hand when they are used in dipping paints.

The materials, especially heavy varnishes and enamels, are more fluid and spray more freely when the air is hot. In fact, the material itself can be heated

Figure 26

MODEL-N. PAASCHE PNEUMATIC BRUSH.
AIR HOSE



Oil and Water Separator

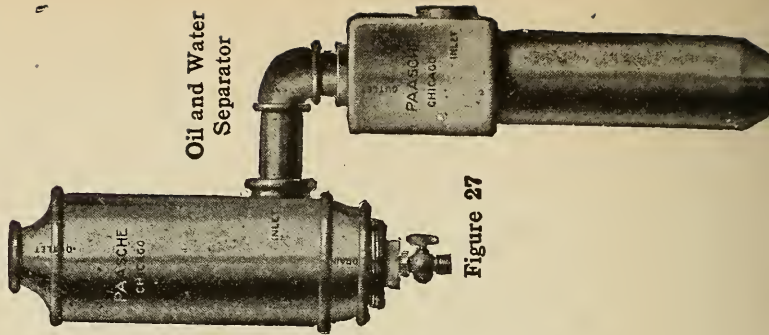
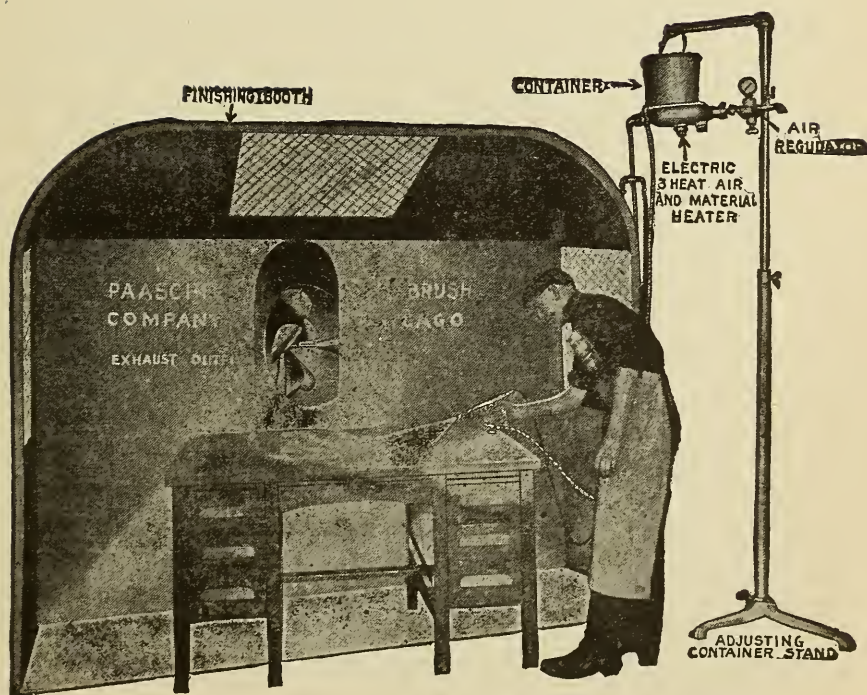
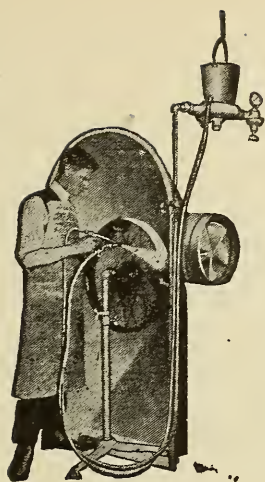


Figure 27

LOW - MED - HIGH HEAT.



Air Heater
Figure 26



Paasche's 8-foot equipment complete to attach to the air line. Most popular equipment among piano and furniture manufacturers.

to advantage. The surface sprayed ought to be not colder than 70°.

There are many variations of this modern instrument but they all have much in common, including those made in Europe. Probably the two best known American manufacturers of spraying instruments are the DeVilbiss Manufacturing Co., Toledo, Ohio; and the Paasche Air Brush Co., Chicago, Ill. Both concerns make instruments and equipment to handle any kind of paint, varnish or enamel. In Figures 24 to 28, will be found illustrations of the Paasch instruments and equipment suggested for use in finishing automobiles.

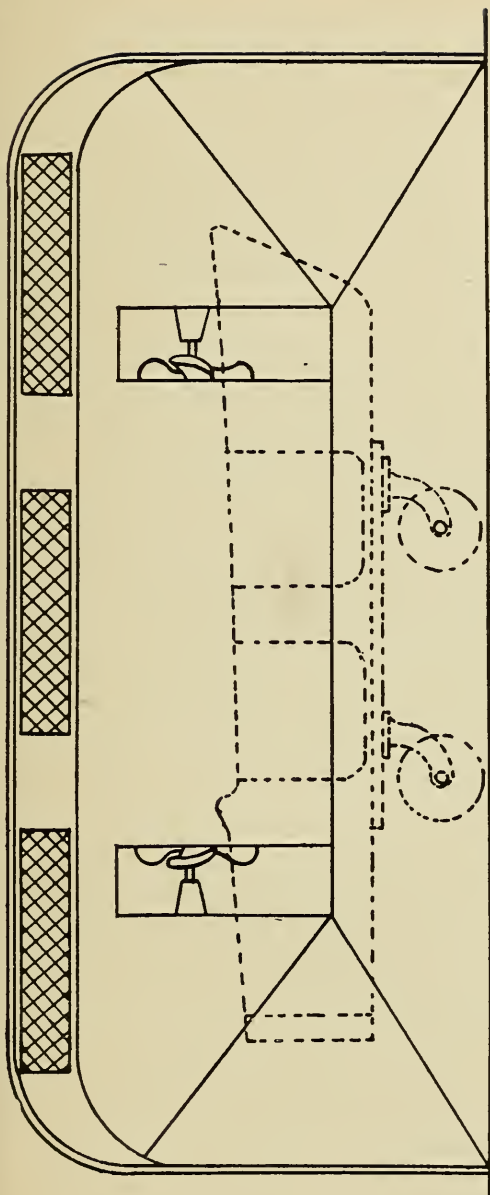
In Figure 24 will be seen the three main units of the Paasche spraying equipment:—Air Brush, Compressor and material container.

Figure 25 gives a sectional view of the working parts of the brush, while Figure 26 shows Air Heater used to warm the air as it passes through the hose. Most varnishes, enamels and paints flow together on the surface and produce a finer job when hot air is used.

Figure 27 is an Oil and Water Separator. The air compressor, like all other pieces of machinery with moving parts, must be supplied with oil. From the cylinder the oil gets into the hose air line and then to the brush and when mixed with the paint or varnish being sprayed interferes with getting a nice surface. Water gets into the air hose through changes in temperature, which cause the metal lined hose to sweat. On lowering the temperature the air condenses, leaving some water inside of the hose compressor and tank. The simple mechanical attachment shown removes both water and oil from the air as it passes through on its way to the brush.

Other attachments which serve to bring this outfit up to a high point of efficiency are an Air Regulator, by which any desired pressure on the brush may be steadily maintained, regardless of what pressure is registered in the compressor tank, and an Automatic

FRONT ELEVATION



SIDE ELEVATION

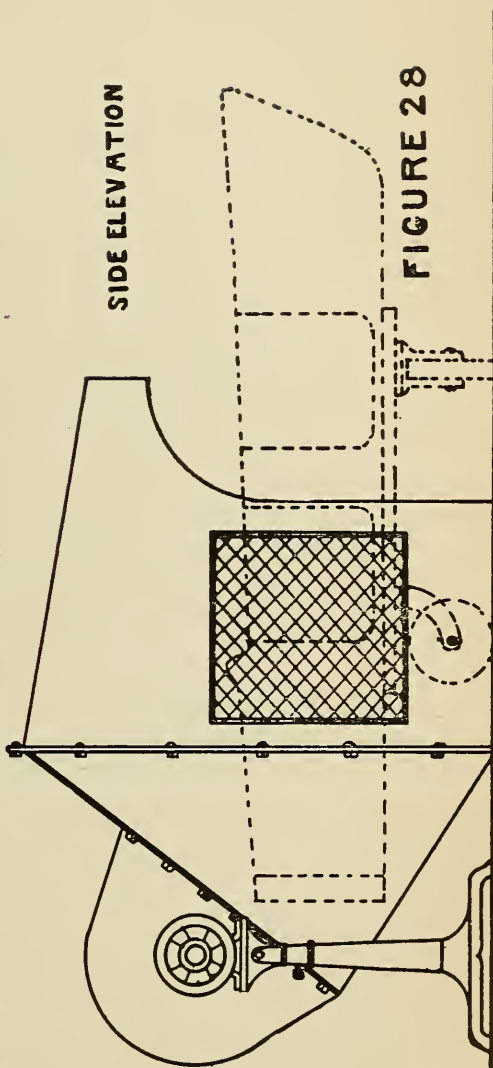


FIGURE 28

Electric Controller, with which the compressor is started and stopped.

Figure 28 illustrates the Auto Finishing Cabinet and the position of a body on a truck while being sprayed. In the top and sides of the cabinet, which by the way are made of sheet iron on a steel angle frame, are placed glass to let in as much light as possible. Electric lights are usually placed in the top also. In the back of the cabinet is quite a large opening through which the fumes from the paint being sprayed are drawn out of the cabinet by an exhaust fan, run by an electric motor usually, and carried through large metal pipes discharging outside of the building. This avoids the "benzine jag," as the workmen describe the effect upon them of using so much volatile liquid, the gas from which fills the air when no cabinet or fan are in use. These cabinets are made in many sizes to fit the different parts of a car which are sprayed.

In large factories where dozens of cabinets and air brush outfits are in use, the compressed air is piped to the brushes from the engine room, where a large compressor outfit supplies air more satisfactorily than many small compressors could and with less trouble and expense.

Following are listed two complete spraying outfits of the Paasche type together with information of interest taken from published directions for operating such equipment:

PAASCHE AIR BRUSH OUTFITS

Equipment needed by an automobile repair shop and repainting establishment:

Model "N." No. 3 Paasche Air Brush with gravity feed metal cup.....	\$ 28.75
Extra nozzle No. 1 for use with small parts and light liquids	3.00
1 length air hose with couplings.....	1.50
1 4' Finishing Cabinet.....	24.00
1 No. 16 Superior Exhaust Outfit.....	54.00
1 No. 31 Air Comperssor Outfit, mounted on metal base in one unit, complete ready to attach to any power line, electric motor or gasoline engine.....	82.50
Approximate cost.....	\$ 194.75

Air brush finishing equipment such as are furnished automboile or wagon works. Consist of the following medium sized equipment:

1 16' Paasche Superior Finishing Cabinet, 8' high, 16' wide, 12' deep.....	\$ 185.00
2 No. 24 Superior Exhaust Outfits.....	220.00
1 Model "N" No. 3 Paasche Air Brush with 4 gallon container, hose agitators and fittings complete....	37.50
1 Extra Model "N" 5 material adjusting parts for use with heavy paints on large surfaces.....	3.00
1 Extra "N" 5 air cap and guide and 10' length air hose with couplings.....	2.50
1 Gravity feed metal cup for sample work and experimental purposes	1.75
Water and Oil Separator, regulator with gauge and ittings for electric, air and material heater unit...	51.00

Approximate cost\$ 500.75

Air compressor outfits for equipment of this kind are furnished in different sizes to accommodate from two to thirty or forty brushes and have to be quoted accordingly.

For the most successful operation of the Air Brush the air pressure used must be clean, dry, free from moisture, and in most cases, warm. A regulator is used for controlling the pressure which, for heavy materials, ranges from 50 to 80 lbs. The pressure varies in range according to the consistency of the material used. For heavy materials the pressure naturally has to be higher. From 50 to 80 lbs. is required on heavy materials, such as paints, baking enamels, celluloid enamels and varnishes, etc. Shellacs, stains and lighter liquids are applied with from 25 to 45 lbs. pressure.

The construction of these brushes, separating materials entirely from any of the working parts, makes it unnecessary to soak the brush every night. For this reason it can be left connected to the varnish or material supply and used for weeks without cleaning. We, however, recommend the removal of the color ad-

justing parts once a week for thorough cleaning.

Color adjusting parts (nozzles) are made in six sizes: No. 0, very fine for use with shellacs and very light liquids on rods, spindle work, chairs and small metal parts, also stencil and decorative work. Parts No. 1 are twice the capacity of parts No. 0. Parts No. 2, twice the capacity of No. 1, and the rest of the parts correspondingly of twice the capacity of the next size smaller. No. 3 is most extensively used for paints, enamels, varnishes on medium size work. Parts No. 4 are used for heavier materials and on large surfaces. Parts No. 5, the largest size, are used for very large surfaces where heavy materials are to be applied very rapidly. An extra set of parts should be kept on hand, as this will almost take the place of another brush, should the part in use need repairing or attention. Special nozzles made of tempered steel are furnished for metal and wood fillers, for use with gritty and cutting materials which can be used in these brushes without the slightest harm or injury, as the material does not get into any of the working parts of the brushes.

Interchangeable parts feature makes it possible to use any size parts, underslung bottle, gravity feed metal cup, overhead container or pressure feed material containers.

When overhead containers are used the brush can be left connected to the material hose as long as there is sufficient material in the container to cover the outlet. The automatic closing of the nozzle prevents air getting into the material and for this reason it cannot dry or harden in the brush. When cleaning use underslung bottle filled with a good solvent or cleaning medium and attach bottle to the brush,—pull the trigger and the air will draw this cleaning medium through the color parts dissolving the material inside of same.

After all connections have been made, material placed in the container or cup. air pressure regulated to proper pressure for material used, the brush is ready for operation.

The first short pull of the trigger permits only air to go through the brush. It is in this way used for dusting and blowing off work. By pulling further backward on the trigger the material valve gradually opens and will furnish from a line to any size spray wanted according to the different positions the trigger is held in. This excellent control facilitates covering more surface with less material than with any other brush made and a little practice on the part of the operator should familiarize him with the continual opening and closing or starting and stopping of the brush. With a few days' practice, he will be able to apply the lightest or heaviest coat perfectly even and uniform, without sags or runs.

Should the work finished show sags or runs, it is due to uneven coating and the inexperience of the operator in the control and proper use of the trigger. This, however, is very easily overcome with practice which will reveal the unlimited and wonderful possibilities of the air brush.

We recommend that new operators practice with under coats until sufficient experience is gained to apply last coat with accuracy and precision.

For narrow work where a small spray is necessary, the brush is held approximately four to six inches from the surface. Where very big and heavy spray is required for larger surfaces, the brush is held approximately 12 to 16 inches from the surface.

Should the finish appear dotted or rough, the material may be too heavy, the pressure too light or there may be moisture in the air, such as water or oil from air compressor, caused by condensation in air line. To remove this we recommend separators and electric heaters.

Gravity feed metal cups are made in pint and quart sizes. These are recommended for use with heavy materials used in small quantities. Overhead containers are furnished in one, two and four gallon sizes. These eliminate continual filling, makes the brush much lighter and convenient to operate and to get into

awkward places. They are for this reason the most extensively used. Underslung bottles are used for bronzes, materials that settle very fast, and very light liquids used in small quantities. The underslung bottle is also used for cleaning, by keeping a bottle for this purpose filled with cleaning medium ready to attach when changing from one material to another or cleaning the brush after it has been used, it saves a good deal of time and does away with removing the color parts for cleaning.

Agitators are furnished with overhead containers to keep all heavy materials that have a tendency to settle, well stirred. All materials used in an air brush should be well stirred, strained and free from lumps and grit before filling the containers, as this will eliminate clogging in the hose as well as to produce a much higher grade and better finish.

Trigger No. 3 will furnish a strong blast of air for cleaning purposes by pulling it back sufficiently to strike trigger No. 22. Then the air valve only opens, making it very convenient to blow out chips, dust or dirt off the surface parts to be finished. By pulling trigger No. 3 further back, trigger No. 22 opens material valve gradually, and in this way instantly furnishes a light or heavy stream as is required for the largest or smallest surfaces to be finished.

THE FLOWING-ON PROCESS.

Section 30.

This is a quite recent modification of the dipping process in one sense, and yet it resembles spraying in some respects. It is used mostly, if not solely, by automobile manufacturers for finishing bodies. The process consists, mainly, of two different ways to flood the surface with paint, enamel or varnish, allowing the excess of material to drain off into drip pans, where it collects and flows through strainers back into the tank from which it came. This process depends entirely upon gravity to force the paint from the supply

tank through the hose and out of the nozzle.

The possibilities of this finishing method are really great, both for factory finishing and for use by the job shop painter. The practical value of such a method for applying paint, enamel and varnish is being demonstrated by most automobile manufacturing plants today, among them the Ford, Franklin, Overland and others. There are, to be sure, some little variations in the details of the method as used by each manufacturer, but the general principles are followed alike by all.

Referring to Figure 29. The material to be flowed on to the body is placed in an overhead metal tank which may be any size, from five to fifty gallon capacity, having a tight cover to keep dust out and prevent the material from skinning over the top if allowed to stand unused for a while. An air opening must be made in the top of the tank when using. The atmospheric pressure is needed to force the material through the hose. Gravity will not overcome the vacuum in a closed tank.

A large tank would no doubt require some mechanical revolving paddle arrangement to keep heavy pigment paint stirred up. Small tanks emptied often can be stirred sufficiently with a hand paddle. Large tanks had best be located on the floor above the finishing room, while smaller ones might be made fast to a rope run over a pulley fastened to the ceiling. Then it could be hoisted up ten or fifteen feet when in use and dropped down to be cleaned and filled. The larger the tank and volume of material in it and the higher up it is raised, the more force the stream of material coming out of the nozzle will have. A very strong flow is not wanted. A wide ribbon of material with force enough to carry four to six inches out and away from the nozzle is about right. It should flow like water out of a garden hose under low pressure.

The small tanks are to be preferred when only a few bodies are to be finished the same color and when for any reason a large batch of one color is not to be

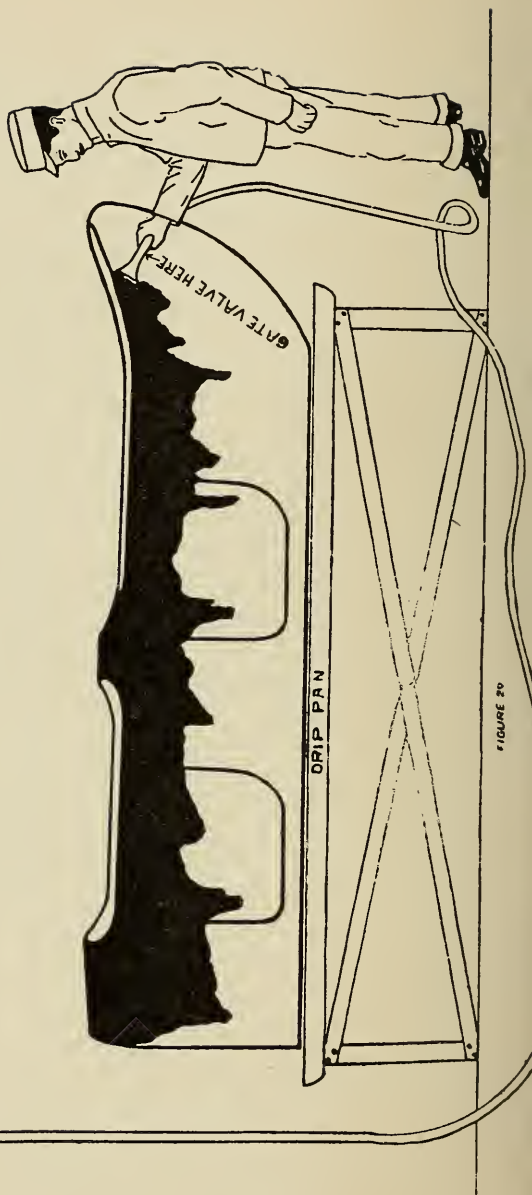


FIGURE 20

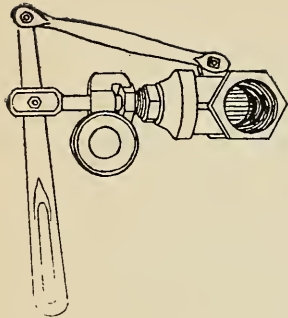


FIGURE 3

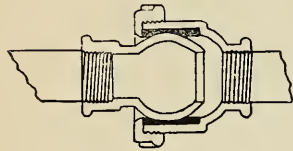


FIGURE 30

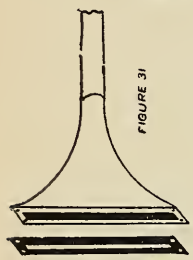


FIGURE 31

mixed up. A tank of small diameter but quite high would give a more steady pressure with a small quantity of material than one large in diameter and a shallow depth of material in it.

Just above the hose connection at the bottom of the tank, Figure 29, a shut-off cock is needed so the material can be shut off and the hose removed without draining the tank, if need be.

Next below this cock should be placed a flexible pipe joint, like Figure 30, to which the material hose is fastened. It is called the "Barso" Flexible Joint, $1\frac{1}{4}$ or $1\frac{1}{2}$ inches in diameter, and can be bought through any steamfitter or from The Crane Co., Chicago, Ill. This joint permits the hose to move in any direction freely so the nozzle on the other end may be carried from one side of the auto body to the other while flowing on the material.

The hose carrying the material from tank to nozzle must be flexible and metal lined. It costs about twenty-five cents per foot and must be long enough to be handled freely on all sides of the car body. The hose should remain as nearly perpendicular as possible while in use so the material will have a free flow unobstructed by kinks. A hose of $1\frac{1}{4}$ inch or $1\frac{1}{2}$ inch diameter is about right. It is well to suspend the tank as nearly over the center of the car body as possible to help give the hose freedom of action in use.

The nozzle is quite different than spray nozzles, being simply a metal spout with a slotted opening about four inches long and from one-sixteenth to three-sixteenths of an inch wide through which the material can flow out in a flat ribbon shaped volume. A thin mixture would work best with a narrower slot than is needed for thick, slow moving varnishes and enamels. The nozzle should be made with a one-half inch wide slot. Then two or three plates having narrower slots, one-sixteenth, one-eighth and one-quarter inch wide could be kept on hand. The one which works best with the material being used can be quickly screwed on to the nozzle and changed when a different material

is used. Figure 31 shows such an arrangement on a nozzle with a shut off valve in it to start and stop the flow of material. It looks quite like a vacuum cleaner metal connection. The shut off valve, Figure 32, should be of the quick opening, straight way, gate type $1\frac{1}{4}$ inches or $1\frac{1}{2}$ inches in diameter to fit the hose. It can be secured from the The Crane Co., Chicago, Ill.

The body to be finished is placed upon a truck, having wheels on it, which is a trifle narrower and shorter than the bottom of the body. It is just high enough to bring the body to a convenient working position.

A drip pan made in the general shape of a horse shoe, is mounted on a firm frame and fastened to the floor. It runs, like a rain gutter on a house, around three sides of the body and directly under the sides and back so as to catch the drip. It is mounted on the frame so the front end of one side of the gutter is enough higher up than the back gutter, and that on the other side of the body, so that the paint which drips into the gutter all runs down hill to the lowest end of the gutter on one side, then through a strainer into a tank. The material, after being strained, is pumped or carried back to the overhead supply tank and used again. The waste is very small indeed. Figure 33 shows this drip pan gutter arrangement.

The amount of material used on a body each coat is usually a little greater than would be put on with a brush, but the number of coats required is less, by at least one, and the durability of the job is increased by the heavier coats.

With the equipment in place and the tank filled with material, place the body on the truck and roll it in between the metal drip pans. With an ordinary bristle brush lay a strip of the paint or varnish to be flowed-on two or three inches wide around the top of both sides and back of the body up next to the upholstery line. It is difficult to flow the material up close to a line with the nozzle, so it saves time to start the coat with an ordinary brush. Of course, the sur-

face is to be clean, free from dust and dirt first.

Hold the nozzle three or four inches from the body, beginning at the top and front of the body side. Open the material valve, and as the material hits the surface, move the nozzle toward the back of the body just fast enough to leave a heavy ribbon of material on the surface that flows downward. Carry the stream continuously around the back and other side to the front. Shut off the material valve. Then go back to the first side coated and flow on more material to the portions not yet covered by the sheet of material running down. Flow considerably more material than is needed on to the top portion of the body so it will flood over the whole surface coming down, making a solid sheet of material and running off at the bottom of the side wall into the drip pans.

Let the job stand ten or fifteen minutes to drip and then run a soft varnish brush along the bottom edge of the body all around to remove the dripping material, or it will dry with a fat edge. It is then ready to be pushed on the truck into the drying room or oven for baking. All coats of material are applied in this manner whether, paint, enamel, color varnish or varnish. Experienced workmen in the factories flow on a coat of material to the body in from two to four minutes, so you can readily see that the process is many times faster than old fashioned brushing, faster even than spraying.

Concerning materials, let it be said that whatever paint, enamel or varnish can be used for dipping is also suitable for the flowing-on method, and it can be used a little thicker than for either spraying or dipping. It is well to buy materials especially made for this purpose by paint manufacturers listed under "Materials" in the first part of this chapter who are aware of the exact qualities such materials need for best results. Undoubtedly, the regular air drying materials used with the ordinary brushing method could be so mixed as to be successfully put on with the flowing method, but of course they could not be baked. A hot room,

80 degrees to 95 degrees about, would hasten drying sufficiently.

The requirements of materials to be flowed-on are:

That it must be thick enough to hide the surface pretty well, but if too thick, it will not flow freely and will wrinkle, sag and cause fat edges.

Enough benzine, turpentine or naphtha must be used to thin the material to the point where it will flow out and together freely, to cover the surface smoothly to a uniform depth all over and then drain off the surplus amount into the drip pans.

Colors, primers, fillers and enamels are usually ground for this purpose in mixing varnish. They should have at least enough quick drying rubbing varnish in the liquid used to thin the paste to bind the paint, to harden it and to cause enough paint to hold to and cover the surface. A little varnish in the mixture causes it to set and stick to the surface. If too much be used, the paint will be too sticky to flow down and drain off as it should.

These paints are made to contain considerable zinc for its fineness, enough lead to give hiding and surfacing qualities and a small percentage of fine silica which helps hold the material to the surface and to flow together. Obviously coarse pigments cannot be flowed on, because they would run right off again and fail to cover. Both zinc and silica, being lighter than lead in specific gravity, help the pigment of the paint to remain in suspension. Usually some white lead is necessary in light colors to get hiding power.

A few experiments on large pieces of sheet iron with various mixtures having different proportions of pigments and thinners will enable one to determine just the right mixtures of paint, color, enamel or varnish of the particular kind being used. Mix by measure, test carefully and observe results; that is the way to succeed with any coating.

Using this method of finishing for low and medium price cars with the enamel process, a fine appearing and durable surface is produced with a priming coat,

a color coat, a coat of egg-shell gloss enamel, one coat of gloss enamel and a coat of finishing varnish. Some plants flow on all coats except the finishing varnish, which is laid on with the ordinary brush and air dried, after being placed in an oven about an hour to set the coat dust-free.

Manufacturers who finish by this flowing-on process find it gives a better surface, quicker and with less work than any other processes used for this class of work. The advantages to be gained by its use are many.

In the first place, the workmen are more easily and quickly taught to produce the right sort of finish with this equipment than any other, especially the ordinary bristle brush finishing.

The amount of money needed to build the equipment is small, indeed, compared to what must be spent to install other kinds.

The flood of material, naturally enough, pushes before it all dust and grit which may not have been cleaned off the surface through oversight, carrying it down to the drip pans with the excess material. In this way a smoother surface results.

Without the use of an ordinary brush, which drags the bristles through the material when spreading it, there are no brush marks, and so the amount of rubbing with pumice stone is reduced to a small fraction of what is usually required, it being necessary to rub only enough to remove dirt nibs and gloss instead of to cut away brush marks. This means a saving of time, a coat of material, labor, and increased production is possible.

The method, when the material is mixed right, lays on a uniform depth of material, more even and smooth, in fact, than can be put in place even by the air brush, as fine a tool as it is. Gravity flows the material down smoothly with an accuracy impossible to be equalled by the hand of man with the most perfect of tools. This method has a future; in fact, its day has arrived. The job shop painter with a little ingenuity, investi-

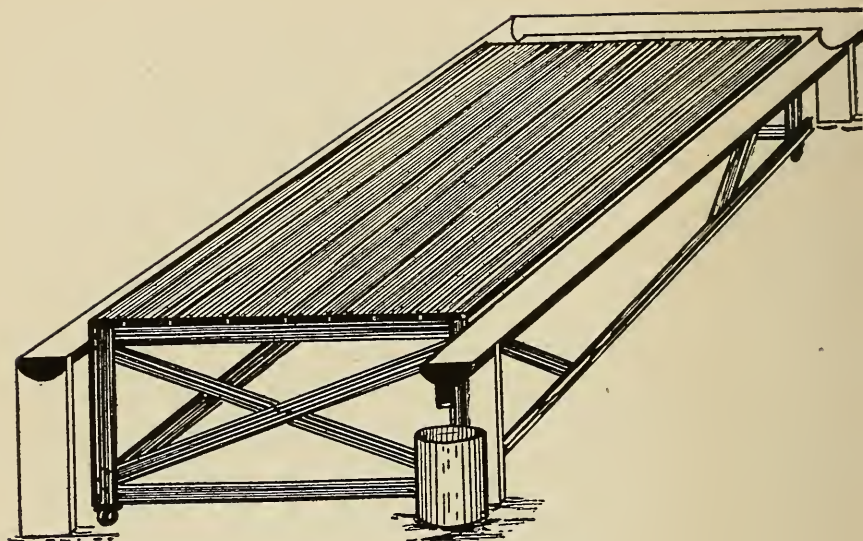


FIGURE 33

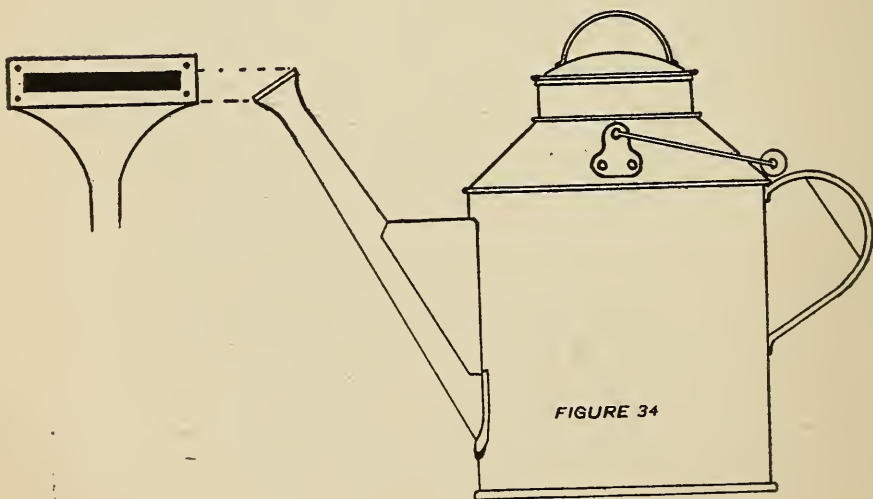


FIGURE 34

gation and experimenting, can use it just as effectively as the manufacturer if he is ready to apply himself to the task, is not too hide-bound and unprogressive to recognize a better, quicker, cheaper way than the old bristle brushing to do first class finishing.

This gravity flowing on process may be simplified to even a greater extent for use by the job shop painter. Figure 34 shows an old style one gallon milk can which has been adapted for use in flowing on materials after no greater change than the soldering of a slotted tin nozzle on to the spout. With the material strained and poured in, the can is lifted and tipped just enough to permit a flat ribbon of material three or four inches wide to flow out of the spout in a steady stream on to the surface. In all other respects the method is carried out as described for using the large overhead tank and hose connection. The slot in the nozzle is not to be large,—from one-eighth to one-quarter of an inch by three or four inches.

The second system for flowing-on material coats produces about the same results by storing the material in a 15 gallon tank mounted on a small truck. Along side of the tank is an electric motor attached to a rotary pump which forces the materials through a flexible hose and out of the nozzle in a flat ribbon volume. A regulator and an overflow are parts of this equipment also.

This equipment and its use comprise what is known as The Floco Process. It is very largely used by manufacturers for the flowing of varnishes and enamels too heavy to be well handled by the air brush and is considered by some an improvement over the gravity flowing-on method. This equipment as well as air brushes is manufactured by the De Vilbiss Mfg. Co., Toledo, Ohio.

DIPPING.

Section 31.

This is about the most simple of all the factory operations. When the correct paint, enamel or varnish

mixture has been secured the success of dipping is insured. The proper equipment to handle the parts dipped is important, but not nearly as much so as the right mixture.

The question of materials has been discussed all through this chapter in connection with spraying and flowing-on, and what has been said in that connection refers equally to materials for dipping. Again let it be said that to purchase the materials in paste form, ready to be thinned down with benzine, from a paint manufacturer who knows how to produce paints for dipping is the best practice.

The material must be fairly thin and still hide the surface well, it must flow together and level up and above all, drain off leaving a coat of uniform depth on the surface without any wrinkles, runs or sags. Dipping is most suitable for articles which are too small to be well handled by brushing or spraying and upon which thin coats are sufficient. Such as fenders, tire rings, shackle bolts, springs, engine parts, torsion rods, brake rods and drag links are all most easily and sufficiently finished by dipping.

Parts to be dipped are usually placed in what are called pickling tanks which contain liquids mixed to remove all grease and mill scale.

Any portion of an article being dipped which ought not to be painted can be coated with vaseline. After dipping, the paint on top of the vaseline can be readily wiped off.

As to the proportion of pigment to thinners little more than a suggestion may be given because that must be adjusted to fit the particular surface being finished. On a metal surface 4 lbs. to 5 lbs. of white pigment, or colors ground in oil or varnish, to the usual paste consistency and thinned with a gallon of benzine or such thinner would make a paint of about the right consistency. Second coats would contain from 4 lbs. to 8 lbs. of white pigment or color ground in oil to the gallon of thinner.

But little linseed oil can be used in dipping paints

as it has a tendency to wrinkle, run and sag. It doesn't set fast enough.

The matter of dipping tanks, dripping platforms, agitators, trolley conveyors, drying racks and elevating devices is too large a subject to cover within the purpose of this book. The variety of such equipment as designed and used by manufacturers in the different lines of manufacture is remarkable. In Figure 35 is shown a common arrangement of a tank and its trolley, agitator and drip board. This will give an idea of the general method. This equipment is made of steel as a rule. Some tanks and drip board are made of wood covered with sheet iron or zinc.

When most articles are raised out of the bath of paint, and after being allowed to drip a few minutes, it is necessary to wipe off the beads of material which collect on the lowest point with a soft brush. Otherwise a fat edge will form.

Long, narrow rods are best dipped vertically and should be hung the same way to drip. Wheels are best dipped in a cylinder shape tank setting upright. They are revolved while in the paint to make sure every part is covered. Then they are pulled up just a few inches out of the paint, but still in the tank, and revolved rapidly to throw off surplus material. Wheels are placed on revolving racks, or rather the wheels are revolved, for a few minutes after coming out of the dip to avoid runs on the spokes. Many plants finish wheels by spraying.

BAKING.

Section 32.

Automobiles and speed are two thoughts which are inseparable. The mention of one calls up the other, so closely are the ideas associated with each other to-day. Speed to the average person refers to the movements of the automobile, but to one who has seen the mechanical production and finishing processes and knows what great things have been accomplished,

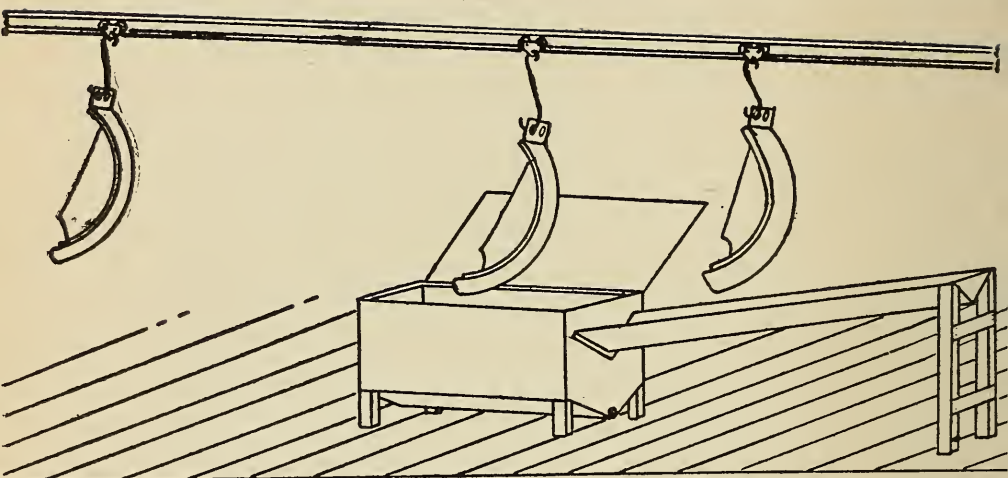


FIGURE 35

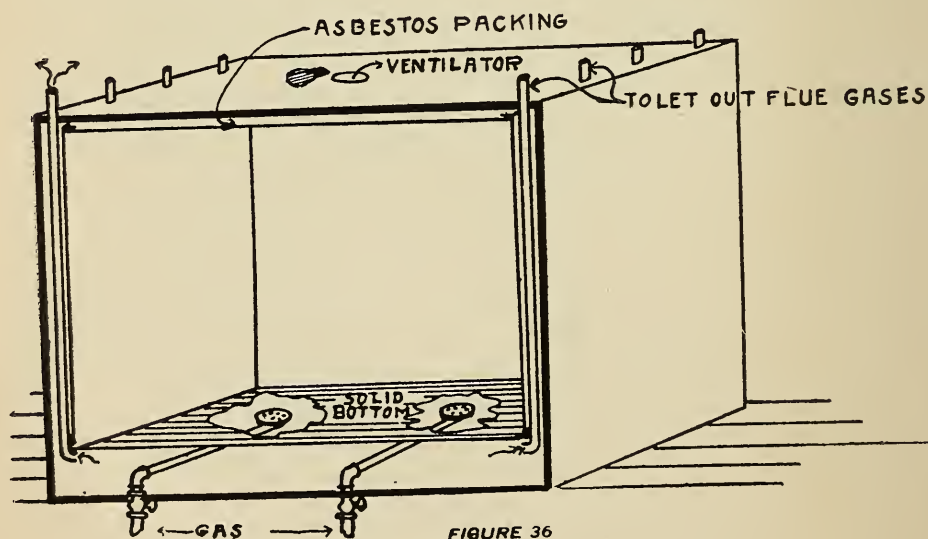


FIGURE 36

speed refers to the building and finishing of a great number of cars in a remarkably short time.

The baking oven is to be credited more than any other equipment with helping along the rate and quantity of production.

Baking ovens have been and are being used for finishing all manner of products made of metal and which are coated by the ordinary brush method, by dipping, spraying or flowing-on. Many kinds of paints, enamels, color varnishes, japans and varnishes are baked, but any material baked must be made for that purpose. Ordinary automobile air drying materials may be hastened in their drying by being placed in hot rooms having a temperature of from 90 degrees to 100 degrees F. A dust proof, ventilated hot room is a fine thing for job shops.

In construction the ovens are generally alike as to principle. Size, drying racks, conveyors, methods of heating, ventilating, regulating, dust and moisture control differ in detail as used by manufacturers of various articles.

In the automobile trade gas is most generally used for heating, although the very latest equipment is heated by electricity. This avoids the problem of drawing off the flue gases and products of combustion resulting from gas heating which spot the enamel being baked if not carried out. Electric ovens require less ventilating, and so keeping them dust free is less difficult. During the early bicycle days small ovens were heated by gasoline burners and by gas. Today many ovens for different products are heated also by steam and hot water radiators or coils of pipes fastened to the walls of the ovens. All that is required is a heating method which will maintain a steady temperature in the oven of from 100 degrees to 250 degrees F for most materials. A thermostat is placed inside and connected with the heating system so it can shut off the heat when need be. And of course, an accurate thermometer is necessary.

Humidity control is essential if the finest of finishes

are to be produced. Moisture is taken into the oven with the air which in large plants is water washed to remove dust before it enters the oven. The air is forced through a chamber completely filled with fine sprays of water from many jets so arranged that the fresh air, which is forced into the chamber by a blower fan through a six to twenty inch pipe, cannot pass out of the chamber until it has forced its way through the water sheet. The water takes out every atom of dust and fibres. The air is then passed over steam or hot water pipes to be made very hot and to drive out excessive moisture before going into the oven. All of the air in an oven is changed about every three or four minutes in large manufacturing plants. Large suction fans are used to force circulation.

The humidity (amount of moisture in the air) is registered by an instrument called a hygrometer. Enamels and varnish color are baked with from 90° to 100° of humidity. Rubbing varnish requires about the same humidity, but finishing varnish requires but 60 degrees to 70 degrees of moisture. Moisture retards the drying of the outside of the paint coat until the underside next to the metal is dry, thus insuring a hard, dry coat all the way through.

Ovens used for small pieces are equipped with hooks, wire baskets or slatted shelves and racks to place the articles on. Fenders are hung from the ceiling on hooks. Axles, bodies and all heavy pieces are mounted on wheeled trucks which are rolled into the ovens and left during the baking. Some ovens are equipped with overhead rail conveyors and some with miniature railroad tracks upon which to carry the enameled articles into and out of the oven.

Baking temperatures vary somewhat according to what each kind of material will stand. The manufacturer who makes the materials should dictate at what temperatures it should be baked for finest results. The list of baking temperatures and the time required to follow is only a general guide. Experts in this line of work are coming to believe that a fairly long baking

period at a moderately high temperature produces a more durable and finer appearing surface than a very high temperature for a short period of baking. Baking at 150 degrees for eight hours is better than 250 degrees for four hours. The priming and undercoats will stand and ought to be baked at a higher temperature than the finishing coats. To secure a hard and dry surface all through and to avoid sweating, the primer should be baked at the highest temperature to be used and the finishing coat at the lowest. Often the last varnish coat is baked only for about an hour at 140 degrees to 160 degrees and then air-dried to finish in a hot room, 80 degrees to 90 degrees.

With baking ovens cars have been finished from the metal up in as few as three and four days, but that is crowding the drying too close to expect durable jobs. In about eight or nine days the work can be done right. The oven offers more uniform drying conditions than can possibly exist outside of it, provided the heating and ventilating can be controlled. It also permits the use of more elastic varnishes without much drier in them which makes for durability of finish. Air drying of varnishes in a reasonable time requires the use of japans and drying agents which are bound to affect the durability some.

BAKING TEMPERATURES AND TIME

Priming Coats	110 to 160 degrees F for 2 to 3 hrs.
Roughstuff Fillers	110 to 140 degrees F for 2 to 3 hrs.
Enamel Surfacer	140 to 200 degrees F for 3 to 4 hrs.
White	100 to 120 degrees F for 3 to 4 hrs.
Lt. Greens, Grays, Blues and Yellows	170 degrees F for 3 to 4 hrs.
Medium Grays, Greens, Blue, Yellows and Bright Red	200 degrees F for 3 to 4 hrs.
Maroons, Browns and Olives	200 to 240 degrees F for 3 to 4 hrs.
Black	200 to 400 degrees F for 4 to 6 hrs.
Varnish, Finishing.....	100 to 160 degrees F for 2 to 4 hrs.
Varnish, Color.....	100 to 120 degrees F for 3 to 4 hrs.
Varnish, Chassis.....	110 to 120 degrees F for 2 to 3 hrs.
Enamels for hoods and fenders	200 to 450 degrees F for 1 to 2 hrs.

Baking paints, varnishes and enamels must be especially tough, elastic and hard drying. They must not change color under the proper amount of heat or when subjected to the correct baking period. Too high a temperature or too long a baking period will discolor most any material. Whites especially take on a yellow cast from too much heat.

All parts to be baked must be free from moisture, grease, dust and dirt. The parts should be air dried a few minutes and then consigned to the oven at a low temperature. The heat may then be raised gradually.

As to the possible use of the baking process by job shop painters, it is obvious that the large oven for high temperatures, electrical equipment, highly developed ventilating and moisture control features are out of his reach. The small oven for fenders, lamps, hoods and such parts is entirely practical when built after the style ovens used a few years ago for bicycle enameling. Figure 36 shows the general construction of gas, steam and hot water heated ovens which may be made large or small to fit the articles to be finished. With small ovens not much attention is paid to washing the air or to humidity, although every precaution should be taken to keep out dust and not have the air taken into the oven from the room too dry.

For body finishing the hot drying room shown in Figure 15 offers a thoroughly practical method for use by job shop painters in increasing production and the quality of their work. It is useful for drying paint and varnish applied in any manner.

The use of small drying and baking ovens in job shops is increasing, although ovens large enough to hold one or more bodies are impractical as yet, except for large manufacturers and they have their troubles with them. They are not to be desired and are not needed by the job shop, the hot drying room with a temperature of 85° to 95° turns the work out rapidly and is sufficient for the needs.

The small oven, large enough for fenders, engine

hoods, radiators, lamps and such parts which are subject to hard service and heat, is possible for every shop and is easily constructed. Such ovens have been in use many years and were in great demand a while back when the bicycle was so popular. Many repair shops put in such ovens and produce nice results after a little experience with baking colors and enamels.

The ovens were simply constructed of sheet iron, using angle iron for the frame. The parts were riveted together. A door with a small glass window through which the thermometer could be seen was placed in front. The top, bottom and sides were double with a dead air space of about three inches between sheets all around. The double bottom was made of extra heavy iron and was raised up off the floor about a foot. Under this bottom was placed one or more gasoline burners, such as are used by circuses for lighting and by the corner popcorn stands. A supply of cooking gas piped into the oven would be much better. By this means the temperature could easily be maintained at 100° or 250°, according to the requirements of the enamel used. Holes in the top covered with slides are used for letting out the gas. See Chapter XIII about baking for further details.

CHAPTER XIV.

The Enameling Process.

This is but another variation of the automobile finishing processes which have come out of the old carriage practices as quicker and better suited to the requirements of the motor car.

It contemplates the use of paint coats (enamels) containing quite a proportion of varnish, after the primer has been laid on, instead of flat drying lead, roughstuff and color coats. The enamel materials used are specially made for that purpose by the same manufacturers as were listed in the chapter on Factory Painting. To have exactly the right material is essential to success and since the enamel process may be operated with different methods of application the material must be mixed to flow and cover in a manner to fit the ordinary bristle brushing, air brushing, flowing-on, dipping or baking, as the case may be.

While it is true that the enameling process is used almost entirely with specially prepared enamels and baking by manufacturers, there is no reason apparent to the writer why it cannot be used with great advantage by the job shop painter. The material would be one of the first class hard drying enamels produced for house decorating such as "Vitalite," the product of Pratt & Lambert, varnish makers, Chicago. Over properly prepared grounds this enamel may be brushed on and it will produce a durable job. For very dark colors it is not so useful, but for finishing in white, all light tints and medium color shades Vitalite is excellent. It comes in various size packages, half gallons, gallons and even smaller, in white only, but may be tinted to suit by adding Japan colors thinned a little and beat up with turpentine.

There may be, and probably are, other first class enamels that could be used this way, but the writer is best acquainted with "Vitalite" and "Ripolin." They dry hard, may be pumice stone rubbed and flow nicely and these qualities are essential. They are, of course, air drying enamels, not baking, although they may be handled to advantage in a hot room, 80° to 95° F.

The enamel process as used by the painter or car owner is suitable for both new cars and those to be repainted. The work would proceed as per the painting schedules given in Chapters V, VI and VII up to the point where the surface is ready for the first flat coat of Japan color. In place of the Japan color a coat of the enamel tinted to suit or white is flowed on full and freely, after being thinned slightly with turpentine. The enamel is to be brushed on in the same way practically as varnish. A small area is coated in at one time, brushed out and smoothed off with light strokes to finish it completely before coating in the next area about one foot square. Flow the enamel on freely with no attempt to brush it out very far. If too much is put on, it will run or fold over itself. These defects must be matched for and carefully brush off the surface before they set. Wipe the brush out as well as you can on the side of the pot before trying to pick up runs and sags.

Allow not less than forty-eight hours for the enamel to dry. A longer time is a great advantage.

Rub down the surface with powdered pumice and water as per Operation 9, and then wash up.

Apply a second coat of the same enamel as it comes from the can, without thinning. At least three days are needed for drying before the car is ready for service. A longer time is quite some advantage in producing the most durable job.

Lettering of initials and monograms must be done on top of this last coat, so a coat of pale auto finishing varnish over the letters only is needed to protect them.

The advantages claimed by the supporters of the process are, chiefly, the reducing of the number of coats; thus cutting down the labor, the cost and the time required for finishing a new car to six or eight days. When very light colors are used they are not thrown off shade by the last coat, in enamel finishing, as when the finishing coat is varnish. The best of varnishes, even, cannot avoid discoloring a delicate surface to some degree. The enamel method produces a nice appearing surface with the minimum of material and that is a virtue to notice, knowing as we do that the metal body will never carry successfully as many coats as the wood carriage surface of old. Few coats, then, favor durability provided they are not too few to protect the metal and themselves.

Briefly, the factory schedule using this finishing method reads about like this, subject to the usual variation in details as practiced at different plants. The operation numbers refer to those listed in Chapter V.

Clean the Surface.....	Operation 1
Sandpaper, No. 1½ to roughen up.....	Operation 2
Dust Off	Operation 6
Prime	Operation 3
Putty and Touch Up.....	Operation 4
Sandpaper, No. 0.....	Operation 5
Dust Off	Operation 6

Enamel paste filler especially made for this purpose is laid on with a three-inch putty knife all over the surface, is allowed to set a few minutes and then scraped off clean except from any hollows or rough places where it is smoothed up and allowed to dry. This is handled like the putty glaze coat in Operation 12.

Sandpaper No. 0.....	Operation 5
Dust Off	Operation 6
Enamel Filler, thin with turpentine just enough to flow out level and lay on smoothly with a soft brush.	

Let dry hard.

Stain Guide Coat.....Operation 8.
 Rub with powdered pumice and water..Operation 9.
 WashOperation 6.
 1 Coat Enamel, colored, to dry flat.
 Rub with Horse Hair.....Operation 11
 1 Coat Enamel, colored, to dry eggshell gloss.
 Rub with powdered pumice and water..Operation 9.
 1 Coat Enamel, colored, full gloss.
 Monograms or Initials, Chapter IX.

- The finish may be left as above or the last gloss enamel coat can be, and sometimes is, rubbed just enough with powdered pumice and water to remove the gloss. A wash-up is made and a coat of clear finishing varnish is laid on.

Having the correct enamels, this method offers quite some advantages over older ones, especially when coupled with the flowing on method of applying the material.

CHAPTER XV.

Color Schemes.

When it comes to the selection of a color or colors for use on an automobile one presumes a lot in attempting to specify in detail just what color treatment should be given this car or that; it is about on a par with an effort to advise a man concerning the color of his neckties, or a woman about her hats. Generally, an automobile should be given the color its owner would like, provided it can be consistently done from the practical viewpoint and that colors selected may be expected to give reasonable service. In other words, the car owner should have as much freedom in the selection of colors as possible as long as such colors harmonize and are practically possible to produce. There are, to be sure, certain standards of good taste to be observed here, as everywhere, when colors are concerned. One wouldn't expect a pure red and a pure yellow, nor straight purple and red to look well for auto bodies and chassis when these combinations are so obviously out of harmony used elsewhere. Nor can it be expected that "loud" "flashy" colors which cause a car to be unduly conspicuous will give an impression of refined good taste. It is entirely possible to have one's car so painted as to be different than the average auto, but yet to have that difference show up as simple, quiet good taste rather than as a flagrant misuse of brilliant strong colors. In other words, have your car noticed because the color treatment is as pleasing as soft music, rather than that it is thrust upon one's sight like a circus van with its red and gold and fancy carvings.

The owner who likes light colors, will select one of the Grays, Cream, Tan, Drab or Straw, while those

who like darker shades choose Browns, Greens, Reds and Blues, which are not so dark in color as to be practically black in appearance. The Chicago and New York automobile shows prove that the public is determined to break away from the conventional black, and, incidentally, from the other very dark colors as well, to the larger adoption of the light tints. Automobile publications have been urging car users to get away from the sombre colors for finer surface effects.

COLOR SUGGESTIONS AND MIXING FORMULAE

A number of color schemes are tabulated here which harmonize perfectly. One will probably be found to suit, but if not, then it surely will be easier to decide on colors which will be just right for you after examining these.

GRAYS.

Taking up the color cards of different color manufacturers we find quite a variety of names listed for this shade, but Gray like most colors may be mixed in such a large number of shades and still be consistently called Gray, that it is not surprising that we have so many names for it. What one manufacturer may be pleased to call Battleship Gray another lists as Torpedo Gray. To be sure, there may be a few degrees difference between the two. Then there are other names given such as Monitor Gray, Detroit Gray, Cadet Gray, Moss Gray, French Gray, Pearl Gray and so on. They range in shade from a very light silver tone to very dark slates. As describing or identifying colors, names do not as a rule mean much more than numbers. One may make a pure Gray by adding a touch of Ivory or Coach Black to white lead, or Flake White as it is called in the carriage trade, and call it Battleship Gray or Detroit Gray. Who can say which name, if either, is correct? But that is neither here nor there. The point to remember is that you may easily mix any particular shade of Gray you wish simply by starting with a white base and adding a little

black to it until it is nearly dark enough. Then if you want to warm it up add a touch of red, American Vermilion, perhaps. If you want a blue gray add a bit of Prussian or Cobalt Blue (not Ultramarine Blue). And if you like the Grays with a yellowish tone add a little Raw Sienna, Chrome or any yellow pigment. The lighter shades of pure gray, and the most attractive shades, are mixed by adding to the Flake White or white lead base a little Black and a little Raw Umber. The Black used alone with white gives a bluish cast to the Gray which the umber offsets.

The Grays are exceedingly practical for auto painting. They are cool colors, quite neutral in tone and among the easiest to keep clean for a car that is always on the go.

A car painted wholly in Gray may not be overly attractive, but when you add to the Gray Body wheels painted in just the right shade of Red, Blue, Green or Yellow, as indicated in the color scheme suggestions to follow, you have a color treatment that is difficult to improve upon.

Number 1.

Body—Gray. A medium to light shade mixed by adding to Flake White a touch of Ivory or Coach Black and a little Raw Umber.

Wheels—Red. A fairly light shade having an orange tone. Add a little Chrome Yellow to American Vermilion, Coach Painters' Red or Phenomenal Red. Ground coats had best be white or pink.

Number 2.

Body—Gray. A pure Gray mixed same as for Number 1 and not too dark.

Wheels—Blue. Just the right shade of Blue is needed to look best. Azure, or Yale Blue are very good just as they come in the can. Ultramarine Blue or Cobalt Blue to which a little zinc white has been added are suitable. Prussian Blue alone is not satisfactory as it has a greenish cast. Many of the darker Blues are suitable after adding a little zinc to lighten them up so they will appear blue, not black. Ground coats for most blues ought to be a light blue.

Number 3.

Body—Gray. A warm shade. Add to white base a little Ivory Black and a touch of Chrome Yellow.

Wheels—Green. A fairly dark shade over quite light ground coats will show up sufficiently green, rather than as black. Milori Green, Fern Leaf Green and Coach Painters' Green, medium or light, are the correct shades. With real light gray bodies, wheels in Olive or Sage Green look well.

Number 4.

Body—Gray. A shade having a bluish tinge to it. Add Ivory Black to a Flake White base to produce a shade about as dark as is wanted. Then add a very small dab of blue. Most any blue except Ultramarine is suitable.

Wheels—Yellow. A shade having a reddish or orange cast is needed. Medium Chrome Yellow is sometimes just right as it comes, but at others it is necessary to add a touch of Vermilion or other red to it. Ground coats, white or light yellow.

Number 5.

Body—Gray. A light gray made with Ivory Black and Flake White.

Wheels—White. Pure White. Use Flake White or white lead ground coats and finish with white enamel.

BROWNS.

Of late the Browns, Tans, Drabs and the many shades closely related to them have come into a well deserved popularity. As body colors there is about them a neatness and effectiveness which brings everyone to the point of admiration, and one does not tire of them easily. They are serviceable and practical above all.

These combinations are pleasing:

Number 6.

Body—Tan. A medium dark shade. Add to a Flake White base a small amount of Raw Sienna until the preferred shade is reached. About 1 part of Raw Sienna to 2 parts white is correct.

Wheels—Cream. Make this by adding just a little Raw Sienna to Flake White or white lead for undercoats and to white enamel for the finishing coat.

Number 7.

Body—Tan. Use one part Raw Sienna to two parts Flake White.

Wheels—Pure White. See Operation 24 about enamel.

Number 8.

Body—Tan. One part Raw Sienna to two parts Flake White.

Wheels—Light Tan. One part Raw Sienna to three or four parts Flake White.

Number 9.

Body—Light Brown. Use Raw Sienna the same shade as it comes in the can.

Wheels—Ivory. A tint that is nearly white. Add but a touch of Raw Sienna or Chrome Yellow to the Flake White.

Number 10.

Body—Light Brown. Raw Sienna color just as it comes in the can.

Wheels—White. See Operation 24 about enamel.

Number 11.

Body—Bedford Stone. This shade really is in the brown class, although its name would not indicate it. Mix by adding a little Raw Sienna and just a touch of Drop Black or Coach Black to Flake White.

Wheels—Cream. Mix by adding a very little Raw Sienna to the Flake White base.

Number 12.

Body—Medium Drab. Another shade which really belongs in the brown class. It is a most serviceable and pretty one. Mix by adding a little Raw Umber and about half as much Raw Sienna to Flake White base.

Wheels—Warm Drab. This may sometimes be called a dark cream. Mix by adding to the Flake White base about half as much Raw Umber as was used for the body color and nearly the same quantity of Raw Sienna as was used for the body color.

Number 13.

Body—Medium Drab. Same shade as for Number 12 suggestion.

Wheels—Cream. Add a little Raw Sienna to Flake White base.

YELLOWS.

Yellows have been used rather extensively for the sporting roadster class of cars of the "Mercer," "Stutz"

and "National" type. The strong yellows which look so well on these cars of small painted surface areas are decidedly out of place on the larger body surfaces of the touring car and closed body pleasure cars. Even when used on the roadster type the strong vivid yellows ought always to be mixed to carry the orange cast to them rather than the greenish tone. Medium Chrome Yellow is suitable, while Lemon Chrome Yellow and Canary Yellow are not. All pale yellows appear best over a pure white ground. Deep yellows are best over salmon ground coats made this way: 4 to 5 parts white lead; 1 part orange chrome yellow; 1 part burnt umber; 1 part Indian red.

For the touring car and closed type pleasure car yellows having an orange cast make pretty colors when modified by adding white to them.

Number 14.

Body—Medium Chrome Yellow. For the roadster type or for a commercial car use this shade just as it comes in the can.

Wheels—Cream. Mix by adding a very little Raw Sienna to the Flake White base.

Number 15.

Body—Same as Number 14.

Wheels—White. See Operation 24 about enamel.

Number 16.

Body—Light Orange. Use one part Medium Chrome Yellow to eight or ten parts of Flake White, then add a touch of American Vermilion or Coach Painters' Red, just enough red to give a slight orange cast.

Wheels—Azure Blue. Ground coats should be a lighter blue than the finishing color coat so the blue will not appear to be black. Use Azure Blue same shade as it comes in the can.

Number 17.

Body—Same as No. 16.

Wheels—White. See Operation 24 about enamel.

Number 18.

Body—Warm Drab. Add a little Raw Sienna and about twice as much Raw Umber to the Flake White base. The tint will be a dark cream color.

Wheels—Cream. Add a very little Raw Sienna to a Flake White base.

Number 19.

Body—Cream. Add a little Raw Sienna to a Flake White base.

Wheels—Coach Painters' Red. Use this shade as it comes in the can. Ground coats, make a lighter red, using Flake White with the red.

Number 20.

Body—Cream. Same as No. 19.

Wheels—Milori Green. Use the deep shade of this green as it comes in the can and over ground coats of a lighter green made by adding a little of this Milori Green to a Flake White base.

Number 21.

Body—Cream. Same as No. 19.

Wheels—Olive Green. Mix with three parts Flake White to one part Raw Sienna. Then add a little Coach Painters' Green, Medium, to bring up to the right shade. A touch of Ivory Black may be needed.

Number 22.

Body—Cream. Same as No. 19.

Wheels—Light Brown. Use Raw Sienna same shade as it comes in the can.

BLUES.

Past seasons have witnessed the use of real blue on but few cars, largely no doubt because some other color occupied attention to the exclusion of others. The very dark blues, to be sure, have been in constant use for years, but most people call these shades black. Few notice that dark blues are not black until compared closely with a vehicle which really is black, an undertaker's funeral car, for instance. Most of the blacks even have some blue in them to offset the grayish tone given by black alone.

A few cars are always to be seen wearing blue shades which are light enough to avoid being thought of as black. And when just the right shades are used they are excelled in beauty and attractiveness by no other color.

The color combinations to follow will give a fair range of choice:

Number 23.

Body—Azure Blue. Use this color same shade as it comes in the can. The ground coats ought to be a lighter blue, made by tinting the Flake White base with a little of the Azure Blue.

Wheels—Light Gray. Formula: 1 oz. Ivory or Drop Black. 10 lbs. Flake White.

Number 24.

Body—Azure Blue. Same as No. 23.

Wheels—Yellow. A very light tint. Formula: 1 oz. Medium Chrome Yellow. 2½ lbs. Flake White.

Number 25.

Body—Azure Blue. Same as No. 23.

Wheels—Ivory. Formula: ½ oz. Medium Chrome Yellow. 12½ lbs. Flake White.

Number 26.

Body—Ultramarine Blue. Use same shade as it comes in can.

Wheels—Straw. Formula: 1 oz. Raw Sienna. 8 lbs. Flake White.

Number 27.

Body—Ultramarine Blue. Use same shade as it comes in the can.

Wheels—White. See Operation 24 about enamel.

Number 28.

Body—Light Ultramarine Blue. Formula: 1 oz. Ultramarine Blue; 5 oz. Zinc White. Ultramarine Blue should never be mixed with Flake White or white lead. It will change lead carbonate (white lead) to lead sulphide, which latter product is black. Use Zinc Oxide for making tints with Ultramarine Blue.

Wheels—Ivory. Same as No. 25.

Number 29.

Body—Light Ultramarine Blue. Formula same as No. 28.

Wheels—Light Gray. Formula: ½ oz. Ivory or Drop Black. 12½ lbs. Flake White.

Number 30.

Body—Perfect Blue. Same shade as it comes in the can. The ground coats should be a lighter blue, or tinted with orange chrome yellow.

Wheels—White. See Operation 24 about enamel.

REDS.

As body colors on pleasure cars the light and bright reds are most properly set aside, leaving them to the exclusive use of the fire department vehicles. The one exception to this is the use of a bright red on vehicles having small bodies or at least having comparatively small surface areas to be painted with this color. The track type roadster is of the kind which may well carry the bright colors. And, of course, there are often business reasons for painting commercial cars in very bright and conspicuous colors.

Especial care is necessary to have the red color pigments well protected with varnish to prevent rapid fading.

Here are some color schemes:

Number 31.

Body—Vermilion. For the roadster. Use American Vermilion same shade as it comes in the can, or add a bit of darker red if too bright. Ground coats to be a pink made with Indian Red and White, or pure white.

Wheels—White. See Operation 24 about enamel.

Number 32.

Body—Wine Color Lake. Same shade as it comes in can. The ground coats should be a medium dark red, not as dark as maroon.

Wheels—Ivory. Same as No. 25.

GREENS.

These colors were popular with pleasure vehicle owners at least a hundred years before the automobile was considered a practical possibility. With our grandparents and theirs a Brewster Green for the family carriage was just the right shade, and it is still a most popular and standard green.

Some greens are not satisfactory because they fade too soon and do not render fair service. It is not difficult, however, to secure good greens which are serviceable and permanent enough for all practical purposes. It is especially important to allow greens plenty of time to dry to avoid having several shades of the same color on the surface.

The greens give you a restful color for the car and one that is always fresh and new to the eye. They offer many color combinations and possibilities. Here are a few of them:

Number 33.

Body—Milori Green. Same shade as it comes in can.
Wheels—Straw. Same as No. 26.

Number 34.

Body—Milori Green. Same shade as it comes in can.
Wheels—White. See Operation 24 for enamel.

Number 35.

Body—Coach Painters' Green. Same shade as it comes in can.
Wheels—Light Gray. Formula same as No. 29.

FENDERS.

From the viewpoint of attractiveness alone a car is usually most successfully painted when the fenders are the same color as the body. The body color on the fenders often does not show up mud and dust so prominently as do black fenders and hence is practical to that extent.

Fenders take more abuse than other parts and are always the first to receive the knocks resulting from accidents. That means repairs and touching up with paint. Then the black fender has much the advantage because it can be easily matched, whereas some of the delicate body colors would offer quite a puzzle in matching unless the original formula were known.

AXLES, SPRINGS AND FRAME.

These parts are not at all prominent and there seems to be no good reason why they ought not always to be painted blue-black or some very dark color. They are usually covered with mud and grease which completely hides any color put on them. Light colors especially are impractical for the under parts.

When the wheels alone are painted with the second color, the color scheme is just as effectively carried out as if the second color were carried to axles, springs, etc.

ENGINE HOOD.

A better looking color treatment will result with most cars by letting the body color extend over the hood also. There are some cars, the sixes with long hoods and bodies, which are effectively painted with black hood.

Hoods are often made black when the car is first painted because the engine heat may discolor some colors. The black is baked on. When it comes to repainting it is entirely safe to use most any color over this baked on black which remains next to the metal.

WHEELS.

The beauty and effective appearance of pure white and light, delicate tints for wheels is conceded by all. They offer some disadvantage, however, from the practical standpoint unless care is taken not to overload the grease packing space in the hubs and thus cause the grease to overflow on to the spokes and rims. Worn out felt dust washers or a loose fitting rear axle housing will cause the same untidy smearing of the outside wheel parts. These are happenings which should not occur either on light tints or dark colors, but when they do the white and light tints, perhaps, look a little more untidy than dark colors.

There is a way to handle white and light tints on wheels which make them quite as practical as any color. Figure 8 illustrates this method. It simply amounts to painting the spokes only with the white or light tint while the metal hub plates and rim are given the body color or some other darker color. For instance, a car having a medium to dark gray body may have the spokes of the wheels painted white while the hubs and rims are red. A green or dark blue body may have wheels painted the same way, using red hubs and white spokes, or ivory spokes.

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